Lessons from South African bank failures 2002 to 2014

by

Roy Charles Havemann

Dissertation presented for the degree of Doctor of Philosophy in Economics in the Faculty of Economic and Management Sciences at Stellenbosch University

Supervisors: Prof. S.A. du Plessis
Prof. J. Fourie

April 2019

The financial assistance of the South African Reserve Bank towards this research is hereby acknowledged. Opinions expressed and conclusions arrived at, are those of the author and are not necessarily to be attributed to the South African Reserve Bank.

Declaration

By submitting this dissertation electronically, I declare that the entirety of the work contained therein is my own, original work, that I am the sole author thereof (save to the extent explicitly otherwise stated), that reproduction and publication thereof by Stellenbosch University will not infringe any third party rights and that I have not previously in its entirety or in part submitted it for obtaining any qualification.

Date: April 2019

Abstract

This study draws lessons from recent South African financial history. The period covers the 2002/3 small bank crisis, the 2008 global financial crisis and the collapse of African Bank in 2014.

During the small bank crisis, twelve banks experienced runs and a further ten deregistered. In chapter 2, I use a monthly bank-level data set to show that the failing banks were all solvent, but that their funding structure made them fragile and susceptible to a confidence shock. The central bank did not intervene to provide liquidity to the affected banks, worsening the crisis. The lessons are that bank failures can impose both short- and long-term economic costs, monetary policy can have financial stability implications, and that a credible and clear bank resolution strategy is critical.

South Africa did not experience any bank failures during the 2008 global financial crisis period. In chapter 3, I show that this is partly because the banking regulator increased capital adequacy ratios during the pre-crisis period, in response to rapid credit growth. The lesson is that macroprudential tools can reduce credit growth and dampen overheating financial cycles.

In chapter 4, the successful bail-in of creditors in African Bank during 2014 provides lessons on the intended and unintended consequences of post-global financial crisis bank resolution tools. Money-market funds 'broke the buck', triggering significant redemptions and some financial spillovers. The authorities required discretionary liquidity restrictions and market-making facilities. The lesson is that – correctly applied – new resolution tools can support the sustainable restructuring of a failing bank, reduce financial spillovers, and minimise taxpayers losses.

The conclusion points to broader lessons from the whole period, particularly the primary importance of a coordinated monetary and financial stability policy framework.

Opsomming

In hierdie studie word lesse uit Suid-Afrika se onlange finansiële geskiedenis ondersoek. Die studie dek die tydperk vanaf die ineenstorting van Saambou in 2002, en die gevolglike kleinbankkrisis, tot die mislukking van African Bank in 2014.

Tydens die kleinbankkrisis het twaalf banke banklope ervaar en nog tien is gederegistreer. In hoofstuk twee wys ek, met behulp van 'n maandelikse bankvlakdatastel, dat dié mislukte banke almal solvent was maar dat hul befondsingstrukture hulle oop gelaat het vir 'n geloofwaardigheidskrisis. Die sentrale bank het nie ingetree om likwiditeit aan hulle te verleen nie, wat die krisis vererger het. Die lesse is dat bankmislukkings kort- én langtermyn ekonomiese gevolge inhou, dat monetêre beleid finansiële stabiliteit kan beïnvloed, en dat geloofwaardige en duidelike strategieë vir bankresolusies onmisbaar is.

Tydens die wêreldwye finansiële krisis van 2008 het Suid-Afrika geen bankmislukkings ervaar nie. Hoofstuk drie wys dat dit deels daaraan toe te skryf is dat die bankreguleerder in die tydperk voor die krisis kapitaaltoereikendheidsverhoudings verhoog het in antwoord op vinnige kredietgroei. Die les is dat makroomsigtigheidsmaatreëls kreditgroei kan beperk en oorverhittende ekonomiese siklusse kan demp.

In hoofstuk 4 verskaf die suksesvolle 'in-redding' ('bail-in') van krediteure van African Bank in 2014 lesse aangaande die bedoelde en onbedoelde gevolge van bankresolusiemaatreëls wat ontwikkel is na die wêreldwye finansiële krisis. Geldmarkfondse het noodontrekkings ervaar, wat beduidende aflossings en finansiële uitkringeffekte tot gevolg gehad het. Die owerhede het diskresionêre likwiditeitsbeperkings en mark-maak fasiliteite vereis. Dit les is dat – korrek toegepas – nuwe bankresolusiemaatreëls die volhoubare herstrukturering van 'n bank kan bevorder, end die finansiële uitkringeffekte en die kostes vir belastingbetalers verminder.

Die slothoofstuk trek breër lesse uit die hele periode, veral die primêre belang van 'n gekoördineerde monetêre en finansiële stabiliteitsbeleidsraamwerk.

Acknowledgements

My thanks to Franklin Allen, Dan Awrey, Chris Axelson, Hugh Campbell, Co-Pierre Georg, Ed Kerby, Amiyatosh Purnanandam, Danie Smit, Stuart Theobald, Caroline Southey, Janet Terblanche and Jeanne Viljoen for valuable comments on earlier versions of this study. My thanks also for the contributions of participants at seminars held at the National Treasury, the South African Reserve Bank, Stellenbosch University, and the University of Cape Town, and the participants at the 2016 Conference on Financial Intermediation in Emerging Markets and the 2017 National Treasury Winter School.

The financial assistance of the South African Reserve Bank and Economic Research South Africa is gratefully acknowledged. The National Treasury generously provided study leave and has over the years sent me to many conferences and workshops on financial stability and regulation, all of which have greatly expanded my thinking on the topic.

My supervisors, Stan du Plessis and Johan Fourie, were always ready with insightful, constructive and valuable critique. Without their enthusiasm and support, this study would never have been completed.

Finally, my family, particularly Steven, for the support over many years. My love and thanks.

Publications

A version of Chapter 3 has appeared in the Economic Research of South Africa working paper series as *Counter-Cyclical Capital Buffers and Interest-Rate Policy as Complements – The Experience of South Africa.*

A version of Chapter 4 is forthcoming as *Can creditor bail-in trigger contagion? The experience of an emerging market* in the *Review of Finance.*

Contents

List of Figures

List of Tables

'For those working to keep our financial system resilient, the enemy is forgetting.'

'What We Need to Fight the Next Financial Crisis'
Ben S. Bernanke, Timothy F. Geithner and Henry M. Paulson Jr.
The New York Times
7 September 2018

Chapter 1

Introduction

Bank failures can impose significant economic losses. Even relatively small failures have led to large, and often unexpected, financial burdens on individuals, governments and society. Internationally, the ten most expensive episodes have been associated with fiscal losses of between 40 and 60 per cent of gross domestic product (Laeven and Valencia, 2013). Recovery from these losses can be slow. In a review of one hundred systemic banking crises, Reinhart and Rogoff (2014) estimate that it takes, on average, eight years for an affected economy to recover to its pre-crisis income level. The decade-long economic recovery from the 2008 global financial crisis is ongoing, and it has been protracted, complex and 'strikingly more tepid' than previous recoveries (Bordo and Haubrich, 2017).

The sharp fall in output, rise in unemployment, and substantial reprioritisation of fiscal resources can have long-lasting political implications. There is evidence that financial and economic crises often precipitate political change, leading to a decline in democracy (Gasiorowski, 1995; Acemoglu and Robinson, 2005; Adam and Karanatsis, 2018). In a review of 800 general elections in twenty advanced economies over 140 years, Funke et al. (2016) show that financial crises lead to an increase in the number of votes for far-right parties of about a third. The majorities held by governing parties decline, parliaments become more fragmented and there is an increase in street protests and riots. The system of financial regulation is thus important, and its effects are 'non-neutral' (Blanchard et al., 2010).

Against this background, there is a rich international literature on financial

crises and banking failures. In contrast, comprehensive analyses of South African bank failures are limited. Three of the most notable global surveys of banking crises, Caprio and Klingebiel (2003), Reinhart and Rogoff (2009) and Laeven and Valencia (2013), either misdate or omit the most significant South African failures.[1]

This study partially fills the gap. It fits into a broader research programme on the history of South African financial crises – complementing a study of a financial crisis in the Dutch Cape Colony (Havemann and Fourie, 2015) and the sovereign crisis of 1985 to 1990, when interest payments on government debt were suspended (Havemann, 2014).

1.1 The international context

Economic and financial crises have led to a better understanding of the central bank's role in preventing bank failures, and managing failures when they occur. The 2008 global financial crisis provided particularly important lessons for central banks. One of the triggers of the crisis was a disorderly collapse in asset prices, particularly house prices, during the course of late 2006 and 2007.[2] Through a

[1] Reinhart and Rogoff (2009, 346) draw from existing literature to identify South African banking crises in 1877 and 1890 but do not elaborate on them, and then mention only a further two: in 1977-78 ('Trust Bank') and 'some banks' in 1989. In their extensive database of banking crises, Caprio and Klingebiel (2003) list 'Trust Bank' in 1977; and merely provides '1989' with a question mark. Laeven and Valencia (2013) list South Africa without any bank failures. These three studies both misdate South African bank failures and exclude significant periods of distress. The 1877 and 1890 dates in Reinhart and Rogoff (2009) are only two of a number of 'banking panics' experienced during the late nineteenth century (Arndt, 1928; Jones, 1999; Verhoef, 2009). A small bank crisis took place in the mid 1970s (Koseff, 1984). The International Monetary Fund systemic failures database contained in Laeven and Valencia (2013) does not record two systemically important banks receiving substantial state assistance – Trust Bank in the late 1970s and Bankorp during the late 1980s, nor does it include the 1970s and 2002/3 small bank crisis.

[2] Dating the crisis is difficult. In much of the (particularly popular) literature, it is dated as 15 September 2008, the day that Lehman's Brothers, a large investment bank, failed. However, Lehman's was only one of a number of financial institutions in distress. The two government-backed mortgage providers, Fannie Mae and Freddie Mac, went into rescue on 7 September 2008, after a few months of difficulties. One day before Lehman's, on 14 September, Merrill Lynch was sold to Bank of America in an attempt to staunch potential contagion. A day after Lehman's, on 16 September, Reserve Primary Fund, a large money-market fund 'broke the buck', i.e. had a capital writedown. Then, on 17 September, the Federal Reserve lent American International Group (AIG) US$85 billion to avoid its liquidation. A nine-day bank run on Washington Mutual led it its collapse on 25 September 2008.

network of complex interlinkages, the house price collapse fed through to banks and non banks.

The effects of the asset price collapse challenged the prevailing intellectual orthodoxy of the time, the 'Bernanke-Gertler consensus', that 'inflation-targeting central banks need not respond to asset prices, except insofar as they affect the inflation forecast' (Bernanke and Gertler, 2001). The way this intellectual consensus was executed in practice is perhaps best summarised by the approach of Alan Greenspan, the Chairman of the Federal Reserve between 1987 and 2006. The 'Greenspan Standard' (Blinder and Reis, 2005) became known as the 'mop up after strategy' or 'clean, don't lean' – asset-price bubbles should be allowed to burst, and after they had burst, monetary policy should be used to protect the system from the fallout ('clean'). Most importantly, monetary policy should not be adjusted *ex ante* to dampen (or 'lean' against) perceived asset-price bubbles.

In retrospect, the Greenspan Standard contributed to the credit-fuelled bubble in asset prices that eventually burst (Saayman, 2010; Borio, 2014; Eichengreen, 2017). This credit-fuelled boom created the impression of a strong economic expansion, but it masked unhealthy fundamentals including that the United States had a large current-account deficit while other parts of the world (particularly China) had large surpluses. This led to a structural flow of savings from the developing world into the United States and other advanced economies. This largely obscured a weak savings rate in the developed world, and created the impression that the rapid growth in investment and consumption growth was sustainable.

The long, apparently benign global expansion (the 'Great Moderation') of 2000 to 2007 had created the illusion that the questions of macroeconomic stabilisation policy had been answered. In his presidential address at the 2003 American Economic Association meetings, Lucas Jr (2003) argued that macroeconomic's 'central problem of depression prevention has been solved, for all practical purposes, and has in fact been solved for many decades.' By 2007, Goodfriend (2007) stated that the 'disarray' of macroeconomics had finally ended. Looking back to this intellectual optimism, Eichengreen (2017) draws a parallel with the 'New Era' – the long boom of the 1920s. The two boom periods, eighty years apart, had a number of common features. In particular, during both, the strong economy and

low interest rates encouraged increased risk taking and politically well-connected, profitable banks discouraged any attempt at tightening of financial regulation, despite concerns about rising asset prices and risks.

The Greenspan Standard had important implications for the institutional structure of central banks and the financial regulatory function. The role of central banks in the financial system and financial regulation became less important. The interest-rate setting function occupied most of central banks' resources and intellectual time (Goodfriend, 2007; Nier, 2009; Turner, 2009). Goodhart (2011) quotes Lord Cobbold's statement that 'a Central Bank is a bank, not a study group', and notes that the crisis highlighted that the central bank's primary responsibility is liquidity and financial stability, not interest-rate setting.[3] This was despite warnings that the culture of the new regulatory authorities could become more focused on legal compliance, rather than on analysing the risks to systemic stability.[4]

Without a financial stability focus, regulators did not continually assess potential risks to financial stability, particularly those posed by a plethora of new and complex financial instruments and financial innovation, including, but not limited to, collateralised debt obligations, mortgage-backed securities, structured notes, credit default swaps, and complex securitisations. There was an almost naïve belief in the ability of sophisticated and experienced market participants to assess the risks posed by these instruments.

The Greenspan Standard was also an ahistoric understanding of the role of central banks (Du Plessis, 2012), which had been created as financial stability institutions, not monetary policy institutions.[5] Most central banks only assumed

[3]This was particularly notable in the United Kingdom. In 1997, the Bank of England was granted independence in the setting of interest rates. At the same time, the banking regulation function was also shifted to the Financial Services Authority. The role of the Bank thus changed significantly.

[4]See Goodhart (2002)'s prescient warning before the crisis and Turner (2009)'s post-mortem. Turner (2009) concludes that in the United Kingdom, shifting banking supervision out of the central bank hampered the coordination between the Bank of England and the new banking regulator (the Financial Services Authority).

[5]The founding objective of the Federal Reserve was 'to furnish an elastic currency, to afford a means of rediscounting commercial paper, and to establish a more effective supervision of banking in the United States.' (Goodfriend and King, 1988). See also Capie et al. (1994). In contrast, Goodfriend (2007) sets out the consensus circa 2007 as having four main pillars – all of which relate to the setting of interest-rates and inflation. His paper on the consensus is notable in that

the role of the independent setting of interest rates during the late 1990s and early 2000s. Even a cursory reading of Friedman and Schwartz (1963), for example, leads one to conclude that a central bank's core responsibility must in some way include bank system health, and concerns about how asset price rises could affect that. One of these historical roles was the lender of last resort function – the traditional role for the central bank to be the ultimate liquidity backstop to the banking system.[6]

The consequence was that central bank models largely excluded asset price fluctuations, did not include financial frictions or have large financial sectors (Du Plessis, 2010), and relied heavily on rational expectations (Saayman, 2011). As as result, central banks did not consider the impact of asset prices in the formulation of monetary policy. This was despite a relatively well-developed literature on the credit and balance balance sheet channels of monetary policy (Bernanke and Blinder, 1988, 1992; Bernanke and Gertler, 1995; Kashyap and Stein, 1995; Kiyotaki and Moore, 1997; Bernanke et al., 1999).[7] Moreover there was an understanding of the potential interaction between low inflation and the build-up of financial imbalances (see, for example, the prescient paper by Borio and Lowe (2002)).

The under-specification of models also led to a misunderstanding of the interaction between monetary policy and asset markets. Taylor (2009), for example, argues that monetary policy had been too loose in the period leading up to the crisis. Borio and Zhu (2012) proposes a formal channel for the mechanism by which loose monetary policy might create credit bubbles, the 'risk-taking channel of monetary policy', echoing earlier work by Rajan (2006). In this view, low interest rates create increased risk appetite encouraging a 'search of yield' (see also Diamond and Rajan (2009)).

Taylor's critique is notable in that he shows that the Federal Reserve kept

it does not mention financial stability once. He does, however, note the inflationary consequences of the liquidity that the Fed provided to the system following the 1987 stock market collapse.

[6] Kindleberger (1996) notes that 'Many high-minded principles suffer from entropy or decay over time, and the lender of last resort may be one of them'. He highlights the long history of the lender of last resort function – it is often ascribed to William Bagehot who described it in 1876. However, the idea can be traced back to Sir Francis Baring and Henry Thornton following a series of crises in the late eighteenth century, particularly one in 1793.

[7] This literature is discussed in more detail in chapter 3.

interest rates artificially low, even within a strict rules-based inflation-targeting framework. The implication is that the Federal Reserve misunderstood the nature of the pre-crisis boom – believing that potential growth was structurally higher. Indeed, Greenspan himself appeared to think that technological progress had structurally accelerated economic growth. Moreover, there is evidence of an asymmetry in how inflation targeting was applied in practice. During period of low inflation, central banks were less inclined to raise rates even with evidence of an asset price bubble – as Issing (2011) notes: 'policy forbearance vís-á-vís dis-inflationary forces fuels financial exuberance and financial exuberance in turn creates financial imbalances.'

Perhaps to the surprise of central bankers, politically central banks were 'blamed' for the 2008 global financial crisis (Geithner, 2014; King, 2016). This was in part because central banks then, as now, fulfilled a number of additional functions which are necessary but not sufficient conditions for financial stability, e.g. management and oversight of the payment system, issuing and distribution of currency and banker to the government. The supervision of the banks that precipitated the 2008 financial crisis, however, did not lie with the central bank. In the United Kingdom, Northern Rock was supervised by the Financial Services Authority and, in the United States, Washington Mutual was supervised by the Federal Deposit Insurance Corporation.[8]

1.2 The contribution

With this well-known international experience in mind, the contribution of this study is to draw lessons from much less researched South African bank failures and periods of financial distress.

Against the background of a limited South African literature, in chapter 2,

[8] Geithner (2014), for example, discusses the problems that this created in the US when Washington Mutual failed. In particular, Washington Mutual was under the supervision of the Federal Deposit Insurance Corporation (FDIC). The FDIC was in favour of a simple closing of the bank, whereas, by Geithner's account, the Treasury and the Federal Reserve were correctly concerned about the knock-on effects. Turner (2009) and King (2016) make a similar points about the failure of Northern Rock. The regulator did not have a financial stability focus and was of the view that Northern Rock posed little risk.

I examine the small bank crisis of 2002/3. The crisis began with the failure of Saambou bank in February 2002. A series of bank runs followed, and within weeks the nation's fifth largest bank (Board of Executors) had failed. In total 22 banks closed, half the banks by number and 10 per cent by size. I show that it was a pure liquidity crisis – affected banks were solvent and well-capitalised, but had fragile funding structures.

The crisis took place in the early years of the 'Greenspan Standard', and the central bank's response reflects this. It did not provide liquidity to the affected banks. In contrast, concerned about the inflationary implications of an exchange-rate depreciation, the central bank raised interest rates as the crisis unfolded. There is no empirical evidence on the balance sheets of individual banks that any of the failing banks received liquidity assistance.

The failure is also relatively unique internationally – South Africa did not have deposit insurance in place, making it one of the few modern uninsured bank runs; depositors had extensive *ex ante* information; and the affected banks were solvent and well capitalised.

Beyond the historical contribution, the chapter also underscores the role of a central bank to stabilise the financial system through periods of substantial liquidity stress, and the importance of a coherent and consistent approach between the financial stability function and the monetary policy function. I show that these two functions cannot operate in isolation from one another.

The contribution of chapter 3 is to provide a case study of a period where a central bank 'leaned' rather than 'cleaned'. In the run-up to the 2008 global financial crisis, in common with most of the world, South Africa experienced a long economic boom with low inflation. Between 2002 and 2007, average economic growth was 4.6 per cent. Inflation was comfortably inside the target range, averaging 4.2 per cent. Yet credit growth was particularly strong, in hindsight at historic and unsustainable highs. Private sector credit extension growth averaged 17.5 per cent during the period, and house price growth was 20.2 per cent. By all measures, the financial cycle was reaching an unsustainable (in retrospect) peak.

In contrast to other jurisdictions, the banking supervisor responded by raising capital adequacy levels. I show that this constrained credit extension which, in turn, dampened the financial cycle. The banking sector thus entered the 2008

global financial crisis period better capitalised than banks in other jurisdictions. When the crisis hit, asset price growth slowed, but there was no disorderly collapse in any major market.

Amongst the lessons of the global financial crisis was that small failures can have substantial knock-on effects, particularly through a complex web of non-bank financial intermediaries. This forms the backdrop for chapter 4.

Following the failure of African Bank, over fifteen money market funds 'broke the buck', i.e. registered capital writedowns. This was the largest and most significant such episode since Reserve Primary Fund broke the buck the day after Lehman Brothers failed. The potential for a disorderly and extensive financial market dislocation occupied the minds of the authorities during the collapse of African Bank in 2014, a monoline lender funded almost entirely by mutual funds. The authorities deployed a set of post-crisis bank resolution tools during the curatorship of the bank. In particular, the claims of bond holders were written down. I show that the use of a mix of tools during the episode successfully reduced the knock-on effects on the rest of the financial system. The bank was successfully split into a new 'good bank' and the residual bank has slowly been liquidated.

The chapter contributes to the nascent literature on the use of new resolution tools, providing one of the earliest demonstrations of how the post-crisis tools can be deployed to reduce systemic risk.

1.3 The methodological approach

> Some will argue, I suspect, that the approaches of economists and economic historians differ not at all, or that they differ only in that historians use dustier data. Naturally, I will push back against this view. I will argue that the historian's approach differs in that it pays more attention to context, to politics and to institutions when evaluating both the formulation and effects of monetary policy.
>
> Eichengreen (2014)

The study is in the tradition of the work of Friedman and Schwartz (1963); Capie et al. (1994); Calomiris and Gorton (1991); Eichengreen and Mitchener

(2004); Calomiris (2008); Reinhart and Rogoff (2009); Goodhart (2011); Iyer et al. (2012); Eichengreen (2014, 2017) and others, which draw lessons for modern-day central banking and bank regulation from lessons from the experience of the past,[9] particularly case studies on bank failures and the response to those failures.

The approach is an empirical historical one, following the 'data revolution' in the approach to economic history and cliometrics (Fourie, 2016, 2018).

Each chapter takes a different empirical approach. Chapter 2 applies various econometric and machine learning techniques to a new large bank-level data set of 244,776 observations for the 2002 to 2003 period. In chapter 3, I extend the National Treasury's existing macroeconometric model to include the capital adequacy ratio as a policy lever. In chapter 4 I apply panel and other econometric techniques to three mutual fund data sets of quarterly and daily data on mutual funds, including data down to a financial-instrument level.

The remainder of the thesis is structured chronologically, and the dissertation begins with the small bank crisis of 2002/3.

[9] I joined the National Treasury in 2002, and have been close to each of the episodes I cover in this study. While I have attempted a dispassionate empirical study of the period, I cannot hide my own observations of the events. I will return to some of these in the dissertation's conclusion.

Chapter 2

The South African small bank crisis of 2002/3

Following the failure of Saambou bank in February 2002, another seven banks failed within a month, including the fifth-largest, and a further five within a year. In total, twenty-two small and mid-sized banks deregistered over two years: half the total number of banks, and nearly 10 per cent of the deposit base. The banks that failed were all well capitalised and solvent, but had relatively high levels of short-term funding from non-bank financial institutions. The central bank did not intervene to provide liquidity and, concerned about the inflationary consequences of an exchange rate depreciation, it raised interest rates.

2.1 Introduction

The small bank crisis of 2002/3 began with a run on Saambou bank, then South Africa's seventh-largest. In the second half of January 2002 alone, Saambou's retail deposits fell R861 million – 8.8 per cent of all the banks retail deposits, and 5.6 per cent of its liabilities.[1] Estimates vary, but between the start of the run in mid-January and curatorship five weeks later, total outflows were nearly 20 per cent of Saambou's deposits.[2]

[1]Unless otherwise indicated, the data for this section was obtained from the data sets described in section 2.5 below. The exact scale of the run between the end of January and the curatorship a week later is difficult to determine precisely. This is because the bank's deposits were initially frozen, and then limited withdrawals were allowed.

[2]At the conclusion of the curatorship in August, individual deposits were R6.82 billion, suggesting the five-week run could have been as large as R2.9 billion, or 19.2 per cent of Saambou's

The proximate trigger of the run was the announcement on 15 January 2001 by South Africa's then largest bank, ABSA, of significant losses in its microlending subsidiary Unifer. Unifer's non-performing loan provisions were increased by R1.78 billion. The net effect was a R1.045 billion reduction in ABSA's capital, approximately 10.9 per cent of its capital base.[3] Saambou had a very similar clientele to Unifer, suggesting depositors were concerned about 'common exposures.'[4] Saambou had grown rapidly – assets grew by 34.8 per cent in 1999 alone – mainly in unsecured lending.

Table 2.1: Deposit balances, individuals, Saambou, R bn

Rbn			**Term**			**Outflow**	(%*)
	Cash	Short	Medium	Long	Total	Δ Total	
31-Dec-2001	0.499	1.268	0.018	8.007	9.792		-
31-Jan-2002	0.524	1.234	0.028	7.145	8.932	-0.861	-5.6%
Conclusion	0.524	1.234	0.028	5.033	6.820	-2.973	-19.2%

* Percentage of deposits
Source: Bank Supervision monthly statistics

The run was concentrated amongst informed depositors with large balances, who declined to roll over their long-term deposits when the notice period expired. The effect was the same as that of a run, with long-term deposits falling quickly (see Table 2.1).[5] To cover the gap between its assets and liabilities, Saambou accessed interbank funding. Interbank deposits rose from R247 million to R1.027

total deposits (see Table 2.1). Press reports variously state that the run was between R1 billion and R2 billion.

[3]The sudden impact of the news caused ABSA shares to fall by 21 per cent over the course of the day, ultimately closing 16.4 per cent weaker. The banking sector as a whole fell 5.2 per cent. Sanlam, at that stage a 22.8 per cent shareholder in ABSA, fell 5.2 per cent.

[4]In contrast to Saambou, Unifer was almost exclusively a microlender, but both had been persistently understating their losses.

[5]Press reports indicated that the run began with a run on attorney trust funds. Lawyers evidently had had heard rumours that the bank was in difficulty. However, the data neither confirms nor counteracts this claim. Outflows were concentrated in the 'individuals' depositor category (line 23 of the DI-900 bank statistics). Attorneys hold trust money on behalf of individual clients and so for recordkeeping purposes, they appeared to be treated as individuals.

billion, an increase of R782 million, suggesting it obtained money from another bank to make good the shortfall.[6] Liquidity moved in the system from Saambou to larger banks.[7]

From Monday, 4 February 2002, the Saambou share price began to fall rapidly. On Wednesday, 6 February, the intraday share price declined by 46 per cent. It recovered slightly, but ended the day 23 per cent lower. Saambou, however, faced continued deposit outflows and its liquidity position became almost impossible to sustain. It was clearly accessing lending from other banks to cover the shortfall, and these banks were increasingly reluctant to provide liquidity.

During the course of the week, Investec, the largest shareholder, proposed a bail-out package to the authorities, which the authorities declined (Mittner, 2003*a*). By the end of the week, the bank's financial position became impossible to sustain. The curatorship (statutory management) of the bank was announced by Trevor Manuel, the then Minister of Finance on Saturday, 9 February 2002.

2.1.1 Spillovers

The first wave: Sharp runs in March/April 2003

The Saambou curatorship announcement triggered concerns about other small banks. Following the announcement, seven banks immediately experienced runs: BOE Bank, Merrill Lynch, TA Bank, Cadiz, FirstCorp, PSG Investment Bank and International Bank. These banks collectively made up approximately 6.6 per cent of total deposits as at February 2002, with BOE alone comprising 6.5 per cent of deposits.

The BOE run was the most serious. Between the beginning of February and the end of June 2002, BOE liabilities shrank by R8.5 billion, or 17.9 per cent. Of

[6] Matching data from other banks shows that it was most likely FirstRand, which saw a large increase in exposures to other banks over the month (more than R1.44 billion). Surprisingly, it does not appear to be Investec, which at the time owned 41 per cent of Saambou through Fedsure.

[7] At an aggregate level there was a small decrease in deposits by individuals of R1.6 billion. This was approximately 1 per cent of total individual deposits of, which totaled R158 billion. Total deposits (including individuals, government, corporations, etc.) actually increased substantially by R22.9 billion, more than half of which was as a result of an unexpected increase in deposits by other private sector financial institutions of R13.7 billion.

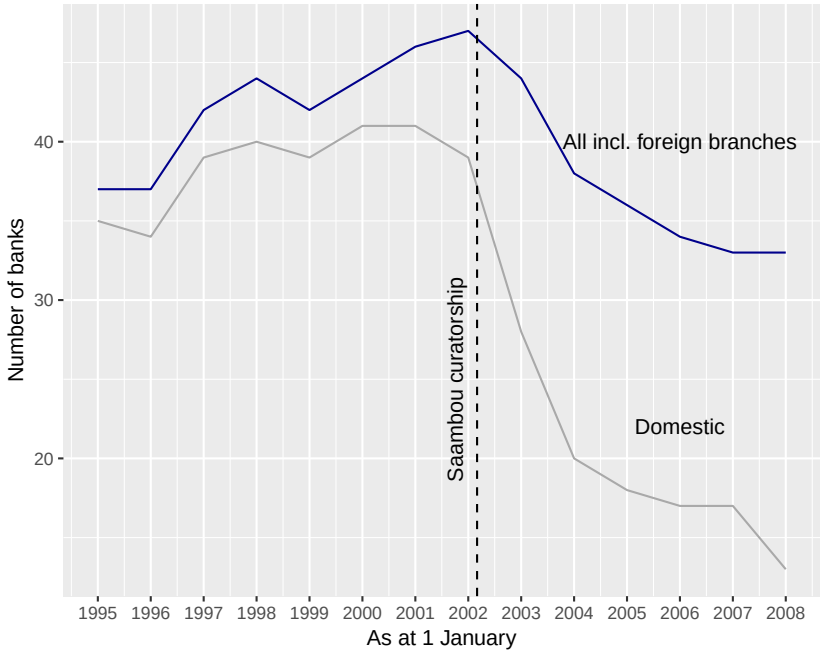


Figure 2.1: Number of banks, 1994 - 2008

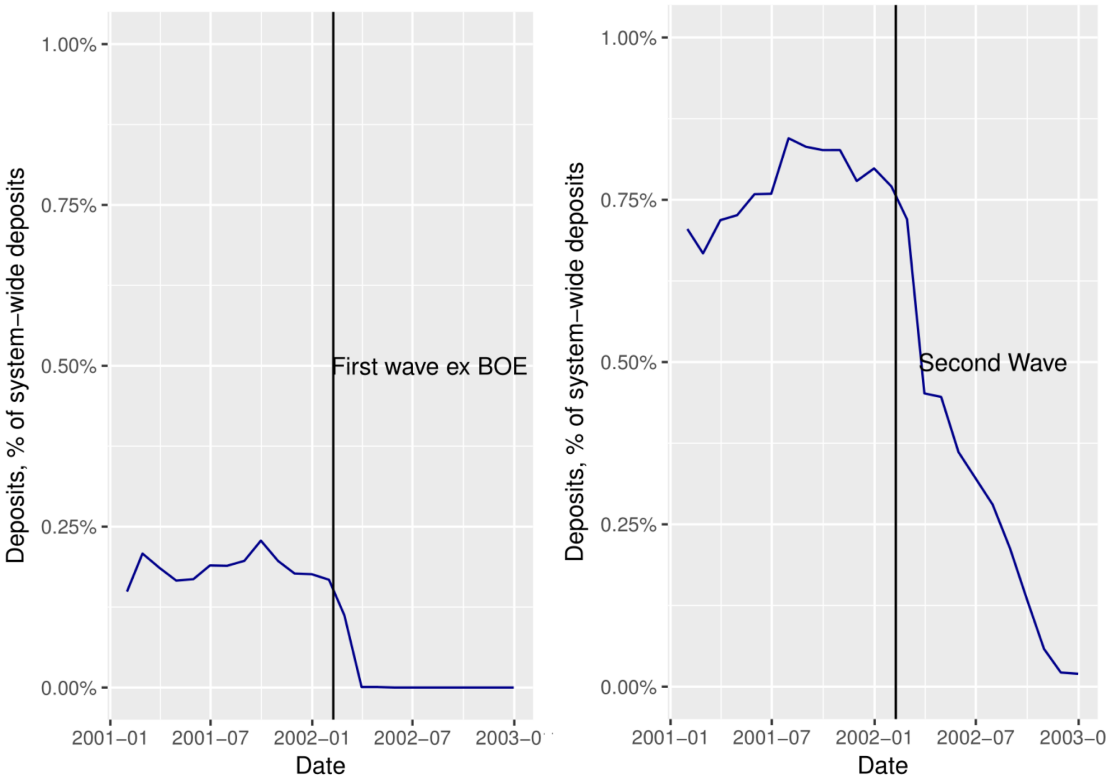
The number of South African registered banks, mutual banks and foreign banks first increased following liberalisation from 1994. However, the Saambou curatorship (dotted line) precipitated a substantial consolidation.

Source: Bank Supervision Department, Annual Reports

this outflow, the largest was by individuals, who withdrew R5.5 billion, followed by other private sector financial institutions, which withdrew R4.5 billion. As with Saambou, BOE accessed interbank funding to make up the shortfall – interbank deposits rose by R3.5 billion. There were net small outflows in other categories.

The authorities provided emergency liquidity assistance to BOE to stabilise the system. A full guarantee of all its assets was provided to BOE on 14 March 2002. BOE was able to continue operating albeit in substantial distress, while a purchase and assumption agreement was negotiated with Nedbank. It was ultimately absorbed into Nedbank, and it deregistered a year later.

At the same time as the run on BOE, the other six banks also experienced runs. At the time, these banks made up 0.11% of the total systemwide deposits. Their



(a) Banks that deregistered during the 'First Wave,' i.e. April 2002.

(b) Banks that deregistered during the 'Second Wave,' i.e. October to Dec 2002.

Figure 2.2: Deposits, failed banks, % system-wide deposits

The 'First Wave' of affected banks saw sharp outflows, while the 'Second Wave' of affected banks saw large, but slightly more gradual declines in their deposit base. Both waves, however, were already experiencing outflows by the time Saambou failed. The vertical line indicates the date of the Saambou curatorship.

entire deposit base was impacted by the run, and by the end of March 2002, the combined deposit base of these banks was nearly zero, as shown in the left-hand panel of Figure 2.2. With the exception of PSG Investment Bank, all these banks deregistered during the course of April 2002.[8]

[8]As noted in Table 2.2, PSG Investment Bank deregistered officially a year later, in April 2003. This was due in part to the attempted restructuring of the bank by a larger group; actions included buying Real Africa Bank. However, because it was affected by the run, it is counted as part of this group.

Table 2.2: Timeline of cancellations and curatorships

Date	Affected bank	% Total deposits (at Feb 2002)
Jan 2002	Unifer announces large loss	
Feb 2002	Saambou*	2.30%
First wave		
Sharp runs		
Mar 2002	BOE**	6.51%
Apr 2002	Merrill Lynch, TA Bank, Cadiz, FirstCorp, International Bank, PSG Inv Bank***	0.11%
Second wave		
Slow runs		
Sep 2002	Brait Merchant Bank	0.16%
Nov 2002	Corpcapital	0.15%
Dec 2002	Old Mutual Bank	0.04%
Feb 2003	SECIB Bank	0.02%
Mar 2003	Unibank	0.34%
	Cumulative	*9.63%*
Third wave		
Consolidation		
Feb 2003	Nedcor Investment and Cape of Good Hope incorporated under Nedbank licence†	
July 2003	ING Bank and Rand Merchant Bank deregister	
Sept 2003	African Merchant Bank deregisters	

This table reflects the dates of curatorship or deregistration, not the date that runs began. In most cases, runs on these banks began earlier. In some cases, liabilities began shrinking before the Saambou collapse. For this reason, a more accurate dating technique is provided in Table 2.5.

* Saambou was placed into curatorship on 9 February 2002. Deregistration only occured towards the end of 2003, once the bank had been fully wound up.

** BOE was given a full going concern guarantee plus emergency liquidity assistance on 14 March 2002. Deregistration, however, only occured in March 2003 when the bank merged with Nedbank.

*** PSG Investment Bank was restructured as part of a comprehensive restructuring of the PSG group. It only formally deregistered in April 2003. For a discussion, see PSG Limited (2003).

† See discussion in section 2.1.1

Source: Annual Report of the Registrar of Banks, 2002 and 2003

The second wave: Slow runs in September 2002 to February 2003

A second wave of bank cancellations took place between September 2002 and February 2003. These banks had significant shareholders and diversified busi-

nesses. However, they were not able to counteract the liquidity pressures in the market at the time, and a general loss of confidence.

Brait Bank cancelled its licence on 30 September 2002, having given shareholders notice of its intention to cancel already in May 2002. It used the period between May and September to slowly wind up the banking business and restructure its assets into a new financial services company (ING Barings, 2002).

The next banks to fail were Corp Capital (29 November), Old Mutual Bank (17 December) and SECIB (end of December). All of these banks experienced depositor outflows as confidence dissipated. The final bank in this group was Unibank. Its depositor behaviour was somewhat unique. It had experienced a short sharp outflow of half of its deposits in April 2002, before briefly stabilising. Over the next year, there appears to be a slow outflow of the remaining liabilities and the bank became increasingly unsustainable, leading to its winding up. It deregistered on 31 March 2003.

The third wave: consolidation and clean-up, February 2003 onward

From February 2003, a further set of banks closed, either through mergers with larger banks or by cancelling their licences. Many of these deregistrations reflected the final winding-up of banks that had experienced runs in 2002. The Registrar of Banks argues in his 2003 Annual Report that these were not runs *per se*, but rather a residual consolidation, and so are not included in the empirical analysis below. The period is best characterised as the 'clean-up' period. On 21 February, Nedbank absorbed the banks it had purchased during 2002 and rationalised the number of bank licences the group held. The affected entities were Nedcor Investment Bank, Cape of Good Hope Bank and BOE Bank, all of which had already been operating under the control of Nedbank. In particular, as discussed above, BOE Bank had been rescued by Nedbank and the deregistration was a formality. The final three deregistrations were merely closures: ING decided at an international level to restructure and close, deregistering on 7 July; Rand Merchant Bank became a division of FirstRand on 28 July and African Merchant Bank closed on 30 September.

A full timeline of failed banks is provided in Table 2.2. In Table 2.5, I provide

a more accurate dating technique, which is discussed below.

2.1.2 The research question

In the context of drawing lessons, the primary research question in this chapter is: why did some banks experience runs and others not? A closely related secondary research question is: of those banks that failed, why did some experience slower runs than others? To answer the question, the paper exploits a firm-level data set of 244,776 observations, made up of detailed balance sheet data for 47 banks over a 24 month period. The next section discusses the contribution to the existing literature, followed by the methodology used, data and results.

2.2 Contribution to the literature

Measured by number of bank failures, the 2002/3 crisis is arguably the most significant banking episode in South African economic history.[9] To my knowledge, there has been no systematic evaluation of the crisis.[10]

The crisis is notable for the lack of any direct interconnectedness between the failing banks. There is a large literature arguing that contagion arises because of interconnectedness (see, for example, Allen and Gale (2000), Haldane and May (2011), or Acemoglu et al. (2015)) and overlapping exposures (as in Nier et al. (2007), Gai et al. (2011), Haldane and May (2011) and Glasserman and Young (2015)). The empirical analysis reveals that the failing banks had relatively low interbank exposures. They had no direct interconnectedness with Saambou (e.g. through overlapping claims). An alternative proposed in the literature is that of 'common exposures' (Ahnert and Georg, 2018), where runs occur on banks with similar assets. However, as will be demonstrated, the loan types of the banks that

[9] The only episode of similar scale is the bank panic of the late 1800s, described in detail by Arndt (1928). There was a small bank crisis in the mid-1970s, described by Stephen Koseff in his MBA thesis, Koseff (1984)

[10] There is some limited discussion of it in Jones (2003), Verhoef (2009) and Gilbert et al. (2009). Mbuya (2003) usefully summarises press reports charting the rise and fall of Saambou (albeit with no discussion of the knock-on effects). Van Tonder (2006) considers the event from a human resources perspective and includes substantial detail on the events before and during the curatorship.

failed were no different from those that did not.

A further point of interest is the rich information set, which was available to depositors *ex ante*. Monthly data published at bank-level was available, including on solvency, liquidity, balance sheet structure and other variables. In the absence of interconnectedness, the theory posits that asymmetric and incomplete information can trigger contagion. Information-based runs arise because of information asymmetries (see Calomiris and Gorton (1991)). This, in turn builds on Diamond and Dybvig (1983), who argues that depositors with incomplete information run. Similar findings are made by Sundararajan and Balino (1991). If depositors have rich information about banks (particularly that they are solvent), then runs should (theoretically) not take place.

At the time, South Africa was one of only a few G-20 nations that did not have a system of deposit insurance in place. There are very few modern banking episodes where deposit insurance is not present in some form (Martin et al., 2017). In this regard, the episode is not dissimilar to the bank failures in the United States during the 'National Banking Period,' the time between the passage of the National Banking Acts of 1863/4 and the creation of the United States Federal Reserve in 1913. There is a rich literature on this period, arguably due to the number of failures and the observed heterogeneity.[11] This literature shows that bank failures may be due to a number of factors, including common exposures (an exposure to a particular type of asset class, e.g. property, unsecured loans), a particular liability structure (e.g. reliance on short-term wholesale funding), or mismanagement (e.g. pursuing low margin business).

Finally, the episode takes place outside of a sovereign distress, in contrast to many other banking episodes, particularly in other emerging markets and indeed some advanced economies (see, for example Kaminsky and Reinhart (1999), Reinhart and Rogoff (2013), Lane (2012) or Provopoulos (2014)).

[11] See, for example, Friedman and Schwartz (1963), DeLong and Summers (1986), Calomiris and Gorton (1991),Calomiris and Mason (2003), Calomiris (2008), Gorton (2008), Gorton et al. (2014) and Jalil (2015)).

2.3 Institutional setting

In the year leading up to the crisis, monetary conditions were relatively loose (see Figure 2.3). The overnight policy rate ('repo rate') had been reduced by 250 bps from 12 per cent to 9.5 per cent during 2001. On the back of the reduction in the policy rate, credit extension rose. Credit growth[12] averaged 6.9 per cent in 2000 and 8.6 per cent in 2001. The increase was most significant in personal loans, which expanded 27.4 per cent in 2000 and 26.7 per cent in 2001. Unifer and Saambou both had substantial exposure to this type of loan.

The reduction in the policy rate was a contributing factor towards a sharp depreciation in the exchange rate, although not the only reason.[13] During the course of 2001, the rand/dollar exchange rate depreciated significantly, from R7.79 a US dollar in January 2001 to R12.13 a dollar in December, a depreciation of 55.6 per cent.

The number of registered banks increased from 35 in 1994 to 41 by 2000,[14] and the number of foreign-owned banks with local branches rose from 4 to 15.[15] The effect was to create a substantially more competitive banking environment.[16]

Against the backdrop of relatively loose monetary policy, and financial liberalisation, there was a rapid expansion of unsecured loans to vulnerable consumers. This was a concern to the authorities.[17] Lenders were guaranteed that payments would be honoured as they would be deducted prior to the employee even having his

[12] Calculated as the monthly average of the year-on-year growth rate.

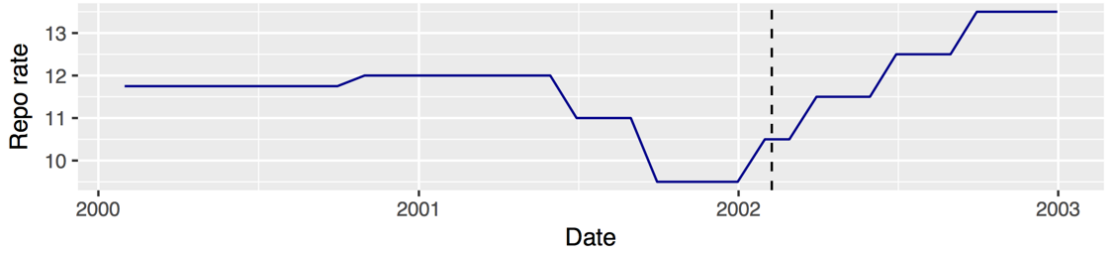
[13] A subsequent Commission of Enquiry could not pin-point a specific reason for the depreciation, but noted a number of contributing factors. These included (i) the reduction in the central bank policy rate; (ii) large foreign direct investment transactions; and (iii) the effective tightening of exchange-control requirements, which created a lack of liquidity in the market.

[14] Information obtained from the Annual Reports of the Registrar of Banks.

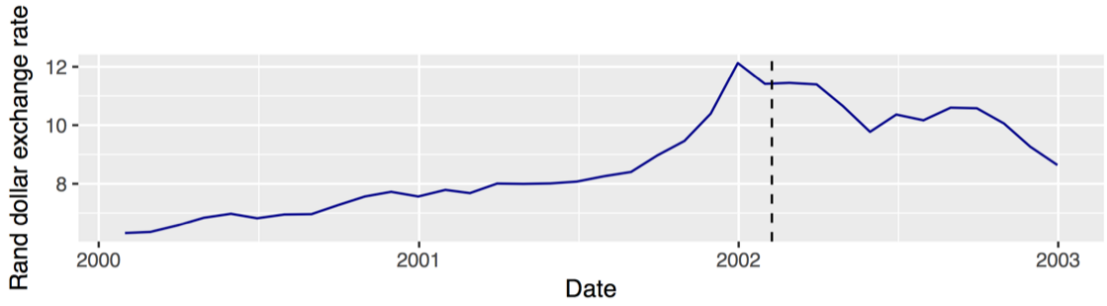
[15] For a discussion of the financial liberalisation initiatives see Jordaan (1997), Jones (2003), Verhoef (2009) and Gilbert et al. (2009).

[16] See also Figure 2.1.

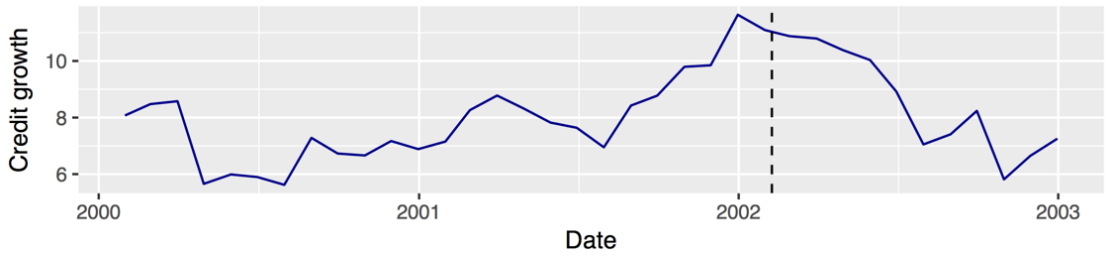
[17] The rise of microlending was one of the defining features of the post 1994 financial system (Porteous and Hazelhurst, 2004). In 1992, to support lending, exemptions to the Usury Act were granted. The effect was to remove the interest rate caps on short-term (less than 36 months) loans of less than R6 000. Microlending had been envisaged to be a way of supporting financing of small entrepreneurs. The experience was different – microlending expanded most strongly as a source of consumer credit. It created increasing distress, and government workers were particularly badly affected by the practice.



(a) Shortly before the Saambou failure, the repo rate was increased by 100 bps. During the midst of the crisis, the repo rate was raised again.



(b) The exchange rate had depreciated rapidly during the course of 2001 reaching an all-time low by the end of the year.



(c) Credit extension had risen rapidly during the course of 2001.

Figure 2.3: Macroeconomic variables, 2000 – 2003

Overnight policy rate ('repo rate'), the exchange rate and private sector credit extension growth. The date of the Saambou failure is indicated by a dashed line.

Source: South African Reserve Bank, monthly data

or her salary paid into their bank account. Arguably the loan was more secure than a secured loan, because secured loans could only be serviced from the remaining money. Despite this, they were charging interest rates as if the loan were unsecured. It was a very profitable, low-risk business.

Table 2.3: Growth in personal loans, selected periods

Period	%
Oct 1995 to Sept 2000 (Automatic deductions stopped)	16.9%
Sept 2000 to Feb 2002 (Saambou failed)	10.7%
Mar 2002 to Dec 2002	0.8%

2.4 Methodology

All South African banks experienced a similar institutional setting, but only some failed. The first research question is: why did certain banks experience a run and others not? The second research question is: why did some banks fail immediately, and others fail later?

To illustrate – out of the ten smallest banks in the sample, only three experienced runs. At the time of the failure, these banks had similar-sized balance sheets, relatively similar capital adequacy levels and operated in a similar market. BOE, the largest and most significant bank that failed, was only marginally smaller than Investec, which was completely unaffected. This was despite Investec holding a significant indirect share of Saambou. Moreover, BOE had a diversified lending book and was not particularly exposed to unsecured lending. The deterioration in the external environment was common to all these banks, but only some appear to have been affected. *A priori*, it appears that there is a set of bank-specific characteristics that caused some banks to experience runs, but others not.

The research questions are approached using a set of techniques, including simple balance sheet scoring techniques, logistic regression, and survival analysis. In the appendix, a set of machine learning techniques are also applied. In the results section, these approaches are compared for predictive power and suitability for real-time risk monitoring.

I consider each of these in more detail below. A summary of the usefulness of each approach is given in Table 2.4.

Table 2.4: Comparison of methodologies

Technique	Estimation	Advantages	Disadvantages
Balance sheet scoring	Probability of a failure in 24 months after t	Can be calculated *ex ante* Computationally simple Easily interpretable Does not require accurate failure dating	Assumes characteristics are time-invariant
Logistic regression	Probability of a failure at any time after t_0	Relatively simple to estimate Does not require accurate failure dating Marginal effects are easily interpretable	Estimated *ex post* Assumes characteristics are time-invariant
Ordered / multinomial logistic regression	Probability of more than one outcome (growing, surviving or failing)	Exploits large number of observations	Marginal effects difficult to compute Requires failure dating
Survival analysis	Probability of a failure at time t	Time to failure	Requires accurate failure dating
Machine learning k-NN	Probability of a failure	Priors about data not needed	Requires substantial data Does not test regressors Requires accurate failure dating

2.4.1 Balance sheet scoring

Regulators typically undertake balance sheet monitoring on a monthly basis, identifying the emergence of risks. The volume of data each bank submits to the regulator is significant, covering multiple aspects of the operations of a bank. A typical bank is required to submit 65,000 items of income statement, balance sheet and cash flow information on a monthly basis.[18]

Given the volume of data, and limited resources, simple balance sheet scoring methodologies are attractive. Moreover, the large literature and experience of using them in practical supervisory roles ensures that they are well suited for *ex ante* prediction of bank failure. This is in contrast to methodologies that rely on *ex post* analysis.

The most widely used technique is 'CAMELS', which is an acronym for the six main components of the regulatory coverage, viz Capital, Asset quality, Management, Earnings, Liabilities, and Sensitivity to market risk. The CAMELS regulatory approach is a well established and widely-used methodology for assessing bank risk Bennett et al. (2015), Hwa et al. (2017), Kupiec et al. (2017), and has proven to be robust and reasonably comprehensive approach for evaluating bank risk. It is particularly appropriate for smaller banks, and forms the basis of the United States Federal Deposit Insurance Corporation (FDIC) approach to bank supervision (FDIC, 2018).

2.4.2 Logistic regression

Balance sheet scoring methodologies rely on an *ex ante* view of the relative importance of different factors in determining the probability of failure. A bank with weak liquidity, but otherwise strong scores in other areas, may still fail. Regression techniques provide an *ex post* approach to determining which factors have historically led to bank failures.

For the first set of analyses, I estimate the probability that a bank would experience a run, based on its own underlying characteristics using a simple regression

[18] Estimated by using the number of data points required by the Regulations for Banks issued by the Minister of Finance.

of the form:

$$P(run_{i,j}|run_{S,j-1}) = \beta_0 + \beta_1 X_{i,j} \tag{2.1}$$

where $P(run_i|run_S)$ is the probability of a run on bank i at time j, conditional on a run having been experienced by the initial node (in this case Saambou) in the prior period, expressed as a function of a constant β_0 and a set of variables X_i at time j. The set of bank specific variables included in X_i are the share of liabilities from financial institutions, a measure of liability growth, deposit growth, share of short-term liabilities, share of assets in financial instruments, capital adequacy ratio, and a measure of non-performing loans.

Logistic regression is well suited for this analysis, and is widely used in the literature. The dependent variable is binary (whether or not a run has occurred) and the independent variables are a set of characteristics of the banks in the sample. It is possible to estimate the marginal effect of a change in an independent variable on the probability of a run occurring.[19] The model is estimated using maximum likelihood methods, and in *R*, the function used is `glm`.

Marginal effects

In a linear regression, the parameter estimates are partial derivatives, dy/dx, or 'marginal effects,' i.e. they provide an estimate of the change in the dependent variable from a change in the independent variable. As logistic regressions are non-linear, the parameter estimates from cannot be interpreted in this way. To sensibly interpret the estimated coefficients, the marginal effects need to be calculated. For continuous variables, the marginal effects measure the instantaneous rate of change, i.e. the impact of a very small change on the dependent variable. The calculation provides a good approximation of the partial effect of impact of changes. The marginal effects are not constant – the impact on the dependent variable will be different at different values of the independent variable.

In the results section below, both the odds ratio and the marginal effects are reported.

[19] A discussion of the approach is provided in Johnston and DiNardo (1997).

2.4.3 Survival models

A logistic regression provides a statistical technique to predict *that* a failure will occur, but does not predict *when* the failure will occur. There may be reason to believe that a set of independent variables may slow a failure (for example, high levels of capital) or speed it up (for example, a liquidity squeeze).

Cox (1972) proposes a regression technique originally developed for use in medical research. It estimates the relationship between the survival time of patients and the underlying characteristics of those patients. The approach has also been extensively used for modelling other event studies with time as a factor. Examples of studies with bankruptcy include Shumway (2001), and for bank failures by Lane et al. (1986), Iyer et al. (2012), Cox et al. (2017), and Martin et al. (2017).

The Cox model specifies a 'hazard function', which introduces time as an element. The hazard $\lambda_i(t)$ for individual i at time t is given as:

$$\lambda_i(t) = \lambda_0(t)e^{X_i(t)\beta} \tag{2.2}$$

where λ_0 is the 'baseline hazard', and β is a vector of coefficents. The equation thus gives the effect on the baseline hazard of a set of coefficients multiplied by a set of variables. To interpret the hazard, one can calculate a 'hazard ratio', which gives the effect of a particular variable on the survival time. Assume, the hazard ratio with two subjects and fixed covariate vectors X_i and X_j, then

$$\frac{\lambda_i(t)}{\lambda_j(t)} = \frac{\lambda_0(t)e^{X_i\beta}}{\lambda_0(t)e^{X_j\beta}} = \frac{e^{X_i\beta}}{e^{X_j\beta}} \tag{2.3}$$

This hazard ratio is constant over time, i.e. the hazard ratio is proportional, hence 'proportional hazard model.'

I use the `coxph` function in the `survival` package available in *R* to implement the Cox proportional hazards approach outlined above. The package calculates the hazard function and the set of β coefficients. The hazard ratio can be interpreted as follows. Where the $HR = 1$, there is no effect, i.e. a unit change in the independent variable has a unit impact on the outcome; Where the $HR < 1$, then a change in that factor causes the likelihood of failure to *decrease*; while if $HR > 1$, then that factor causes the likelihood of failure to increase.

2.4.4 Random forest

The use of machine learning techiques for economic applications has expanded rapidly (Athey, 2017). Decision trees are simple and practical approaches to classifying data, and are a popular classification approach in machine learning environments (Varian, 2014). These techniques have no theoretical underpinning and so provide an atheoretical approach to testing data hypotheses. Most significantly, machine learning techiques provide substantial opportunities for 'big data' (Varian, 2014), being well-suited for trawling large data sets looking for relationships. It is also well suited for algorithmic data analysis – fitting relationships in a structured way. For these reasons, the techniques are valuable during the data exploration phase of the question.

Here, I apply one type of methodology, the random forest decision tree. Decisions trees may provide good predictions because of the use of a large number of explanatory variables (much as a large number of regressors will lead to a high unadjusted R^2). Varian (2014) notes the need to 'prune' the tree, which is simply a means of creating a cost for complexity (almost in the same way that the adjusted R^2 works).

The random forest model sequentially discriminates data into different categories. It is particularly useful for microeconomic questions, providing high out-of-sample fits, and is notably appropriate for highly non-linear data (Varian, 2014). A drawback is that it lacks simple summaries of relationships.

The performance of simple decision trees can be enhanced by expanding the 'tree' to a 'forest', that is, by using multiple trees Varian (2014). The multiple trees are created using bootstrap aggregating of random samples of observations. At each node (decision point, or 'leaf'), a random sample of predictors is chosen. This process is repeated multiple times. The final classification is determined by using a 'majority vote', that is by identifying which tree performed best on an aggregated basis.

2.5 Data

The data set contains monthly data on 217 individual *balance sheet* items for the full sample of 47 banks which had banking licences at the time of the Saambou curatorship, and for which there is sufficient data. A data set is collected from January 2001 to December 2002, giving information on the 13 months prior to the failure and 11 months after. There are 244,776 data points.

The data set is constructed from publicly-available detailed balance sheet data from the Banking Supervision Department of the South African Reserve Bank.[20]

2.5.1 Data pre-processing

From this information, a number of financial ratios and balance sheet items are constructed. These include summary balance sheet items.

There are data for 29 different asset types. These are aggregated into high-level categories, viz: (i) Inter-bank assets; (ii) Resale and installment loans; (iii) Mortgages; (iv) Credit card loans; (v) Loans to companies (non-financial and financial); (vi) Other loans (mainly personal loans to individuals); (vii) Other investments and assets (mainly investments in financial intruments; and (viii) specific provisions.

There is information on twenty liability categories. These are aggregated and summarised into nine main categories: (i) Intergroup; (ii) Interbank; (iii) Public liabilities; (iv) Financial; (v) Non-financial; (vi) Individuals; (vii) Non-profits; (viii) Non-residents; and (ix) Other.

For each liability, tenor is also available in three buckets: short term, medium term and long term. This allows a further set of ratios to be constructed for duration.

This is complemented with historical performance data, including historic liability growth, retail deposit growth, and retail lending growth. Additional information, including estimates of market share (by product line), are also calculated from the date.

[20] Although confidential bank specific information provided by each bank was considered, for replicability and confidentiality reasons, this data was not included.

Finally, there is high-level information available on capital. From this information, a number of ratios are calculated. Following Estrella et al. (2002), four capital adequacy ratios were calculated. The first was a simple equity-to-liabilities. The second was the equity-to-unweighted assets ratio. The third was to follow the Basel approach and calculate a equity-to-risk weighted assets ratio. Finally, a 'solvency ratio' was calculated, with this ratio is defined as asset minus liabilities as a percentage of assets.

The data set is summarised in Appendix B.

2.5.2 Date of failure

For estimation purposes, it is important to define a '*bank failure*' and date it. There are two possible approaches. In the first approach, 'failed banks' can be designated as those that are either placed into curatorship or lose their licences (either voluntarily or because their financial positions have deteriorated significantly). The disadvantage of this approach is that the date of the failure may be too late – typically a licence is only withdrawn at the end of a depositor run. A second disadvantage is that it excludes banks which are rescued. Indeed, during the banking episode, BoE remained technically intact. The run took place in March 2002, but the licence was only withdrawn in early 2003 when the merger with Nedbank was finalised.

In the second approach, failed banks could be determined statistically – for example, banks that experience a run of more than 50 per cent of their deposits over the two-year period are deemed to have 'failed.' This approach side-steps some of the disadvantages above, but has its own disadvantages. Firstly, it is difficult to date the 'failure.' Is it at the end of the run, during the run, or when the run begins? For the banks in the 'second wave,' there is evidence of a slow run. Even banks in the 'first wave' had seen a slow run prior to Saambou curatorship. Secondly, the threshold of 50 per cent is arbitrary. Some banks lost their licences after a run of 20 per cent of their liabilities. Other banks lost all deposits. One international bank saw a plunge in its deposit base during the course of the episode, and managed to restore confidence to the extent that deposits returned.

For these reasons, for the purposes of this chapter, I follow a hybrid of the two

approaches, supplemented with publically-available information. I review each of the 47 banks in the sample, and match their licence information to the behaviour of their liabilities. Only failures in the 12 months following the Saambou failure are considered (the first and second waves), on the basis that it is the short-term contagion we are interested in. Moreover, evidence is sought that failed banks saw large outflows from the date of the Saambou event, i.e. experienced sustained runs. The dates are provided in Table 2.5.

Table 2.5: Dating of failures

Bank	Estimated failure	Cancellation / curatorship
International Bank	30-Sep-01	30-Apr-02
Corpcapital	31-Oct-01	29-Nov-02
TA Bank of SA	31-Dec-01	05-Apr-02
Saambou	15-Jan-02	09-Feb-02
Brait	31-Jan-02	30-Sep-02
PSG Investment	31-Jan-02	31-Oct-02
BOE Bank	31-Jan-02	21-Feb-03
Cadiz	15-Apr-02	15-Apr-02
FirstCorp	17-Apr-02	17-Apr-02
Old Mutual Bank	31-Aug-02	17-Dec-02
Merrill Lynch	15-Sep-02	05-Apr-02
Securities Investment	30-Sep-02	18-Feb-03

This table estimates the date that runs began on the twelve affected banks.
See text for an explanation of the methodology.

This provides us with a set of 12 banks which 'fail,' and 35 banks which 'survive.' As noted above, in total 22 banks left the system, i.e. 10 additional banks deregistered as part of the consolidation. However, using the methodology here, these are not captured as failures – they are part of a third wave of consolidation which is considered separately in a later section.

2.6 Results

2.6.1 Did size and interconnectedness matter?

The extensive data set allows for some preliminary analysis. One hypothesis is that only small banks failed, i.e. that this was a true 'small bank crisis,' which led to the failure of all small banks. From the data analysis, the answer to this appears more nuanced. The four large banks, defined as those with market share of more than 12.5 per cent, did indeed survive. However, out of the two mid-tier banks (banks with a market share of between 2.5 per cent and 12.5 per cent), one failed (BOE) and one survived (Investec). As seen in Figure 2.4, of the group of 41 small banks (those with a market share of less than 2.5 per cent), 11 failed and 30 survived.

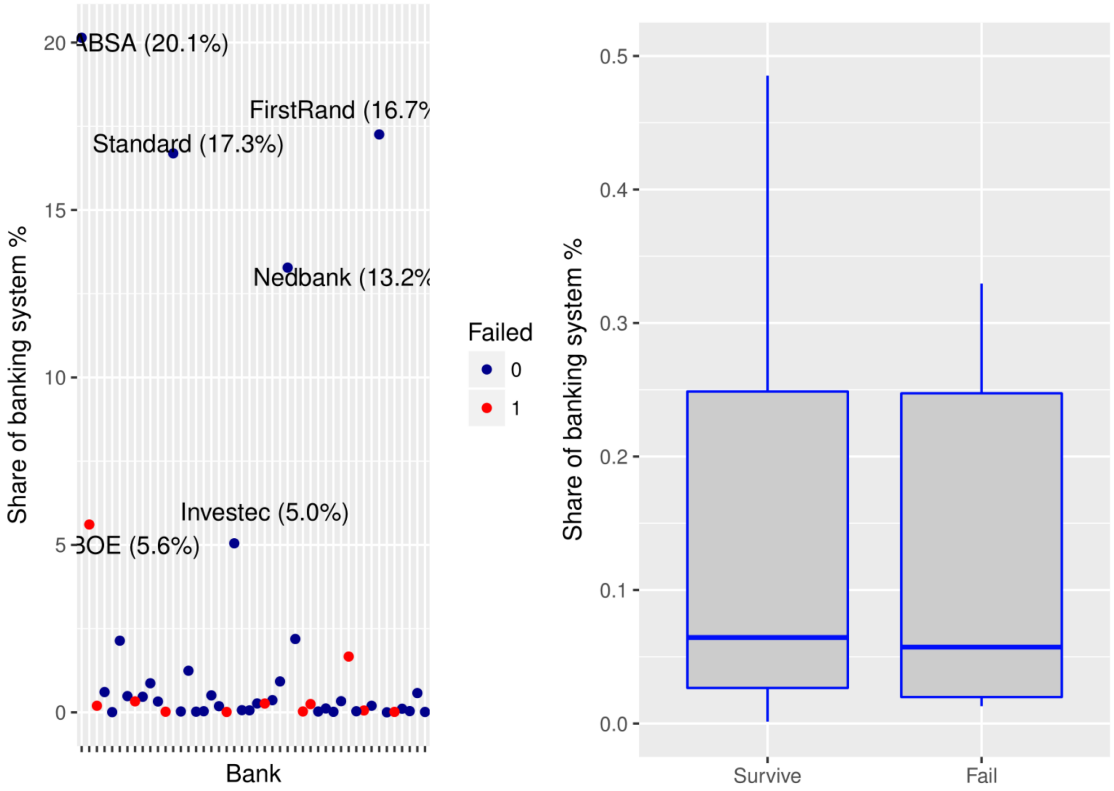
A second simple hypothesis is that the banks were highly connected. The data allows some testing of interconnectedness between banks, and how this interconnectedness changed during the course of the crisis. The authorities intervened with BOE to stabilise its liquidity situation, and this was reflected in a sharp increase in interbank liabilities. For this reason, I exclude BOE from the analysis and focus on the banks that failed.[21] It is notable from Figure 2.5 that there is little evidence that interconnected banks were more likely to fail.

2.6.2 CAMELS analysis

In terms of a CAMELS analysis, three of the components in the CAMELS analysis put forward in Figure 2.6 are notable: capital, liquidity and market risk.

Banks that failed had substantially more capital than those that survived (Panel 1 in Figure 2.6). Moreover, they had better solvency ratios, defined as the difference between assets and liabilities as a percentage of assets (Panel 2). As the failing banks were better capitalised and more solvent than surviving banks, solvency clearly was not the concern. This is a consistent finding across all methodologies.

[21] This only provides aggregate interbank exposures. We also analyse the financial statements of both Saambou and the affected banks, and there is no evidence that there were any interbank linkages between Saambou and the banks that failed.



(a) All very large banks survived (those with a market share of over 12.5% of the system). However, amongst the small banks, failures appear equally distributed.

(b) Box-plots confirm that the size of surviving and failing banks was on average the same. ANOVA tests confirm that small banks were not more likely to fail.

Figure 2.4: Did the size of the bank matter?

Failing banks also had shorter-term, wholesale funding (Panels 7 and 8). The types of liabilities differed significantly: failures had a higher proportion of short-term liabilities and a higher proportion of wholesale liabilities. This suggests that it was not a 'retail deposit' run, but rather a run by short-term wholesale funders.

This is borne out by Panel 10, where it is notable that the failing banks had a smaller proportion of funding from retail depositors than surviving banks. While the Saambou run was due to relatively sophisticated retail depositors, it is clear that the run on other banks was due to a wholesale run. South Africa did not have a deposit insurance scheme at the time of the failure. As it was not a depositor

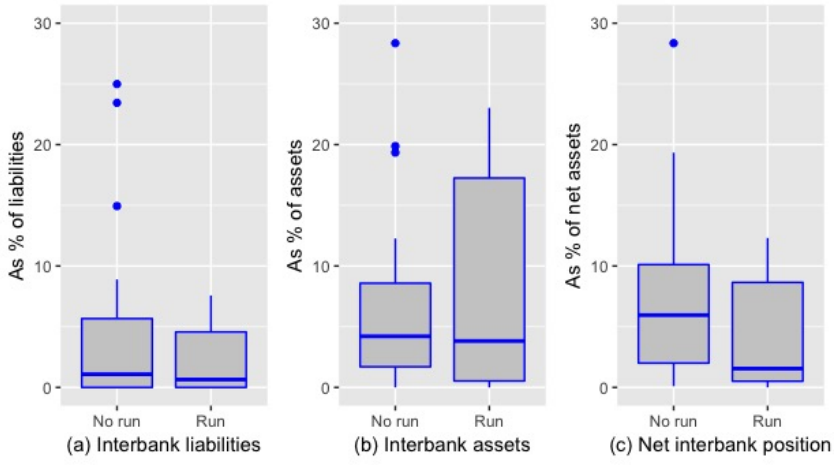


Figure 2.5: Box-and-whisker plots, interconnectedness.

I test the hypothesis that more interconnected banks were more likely to fail following the Saambou failure. There is no evidence with banks with large exposures to other banks were more likely to experience runs. ANOVA tests confirm these results. BOE is excluded as it had a large interbank position due to the liquidity guarantee.

run, deposit insurance would not have staunched the outflow.[22]

The third difference between surviving and failing banks is sensitivity to market risk. This is measured by considering the percentage of the balance sheet invested in financial instruments (defined as investments including trading portfolio assets). Failing banks had a notably higher exposure to these trading assets, suggesting they were particularly affected by movements in share prices, possibly as part of the fall in bank share prices that occurred over the period between Unibank and BOE failing.

The analysis also shows that the failing and surviving banks did not differ substantially in terms of asset quality and earnings (Figure 2.6 presents three types). Non-performing loans as a percentage of total loans and advances were not different between surviving and failing banks. Neither the return on assets nor the types of assets differed – both surviving and failing banks have approximately

[22]The traditional argument for deposit insurance (see Diamond and Dybvig (1983)) is that it avoids a panic depositor run, as bank deposits are safe. In this case, the deposit insurance scheme would have had to apply to non-retail deposits too. Deposit insurance schemes can protect themselves from moral hazard through risk-based premia.

similar exposures to unsecured assets and to mortgages.

2.6.3 Why did some banks fail? Logistic regression results

The preliminary indication from the CAMELS analysis is that that certain banks failed because they were more fragile than others – that is, they had weak balance sheets.

A review of the literature and the CAMELS analysis provide a set of potential variables which could increase the probability of a bank failure. The preliminary CAMELS analysis presented in 2.6 highlights that failing banks had higher levels of capital, higher levels of short-term and wholesale funding, and were more exposed to financial instruments.

The results of a set of logistic regressions, presented in Table 2.6, bear out this initial evidence, and highlight that balance sheet structure influenced the probability of failure. I test a variety of specifications, to ensure robustness of results.

Across all specifications, increased wholesale funding and short-term funding are associated with an increased probability of failure. This is consistent with a view that increased short-term wholesale funding increases bank funding risk, a finding also demonstrated by Huang and Ratnovski (2011) and De Bruyckere et al. (2013) amongst others.

There is a persistently statistically significant coefficient on deposit growth, but the sign is negative. I test for different specifications. In specification 1, I test for the total growth of liabilties in the year prior to the failure. The coefficient is -0.042, with a standard error of 0.017. In an alternative specification, presented as specification 2 of Table 2.6, I use the growth in deposits only (i.e. excluding non-deposit liabilities). In this specification, the coefficient of interest is smaller, but still negative (-0.018, with a standard error of 0.009).

In light of the negative coefficient, the initial evidence in Figure 2.2 is reconsidered. It is notable that on aggregate, the banks that experienced runs in 2002 had already started seeing outflows. This suggests that for whatever reason, there were already indications from depositors about concerns with these banks. This does highlight that these banks may already have been perceived to be weak, and

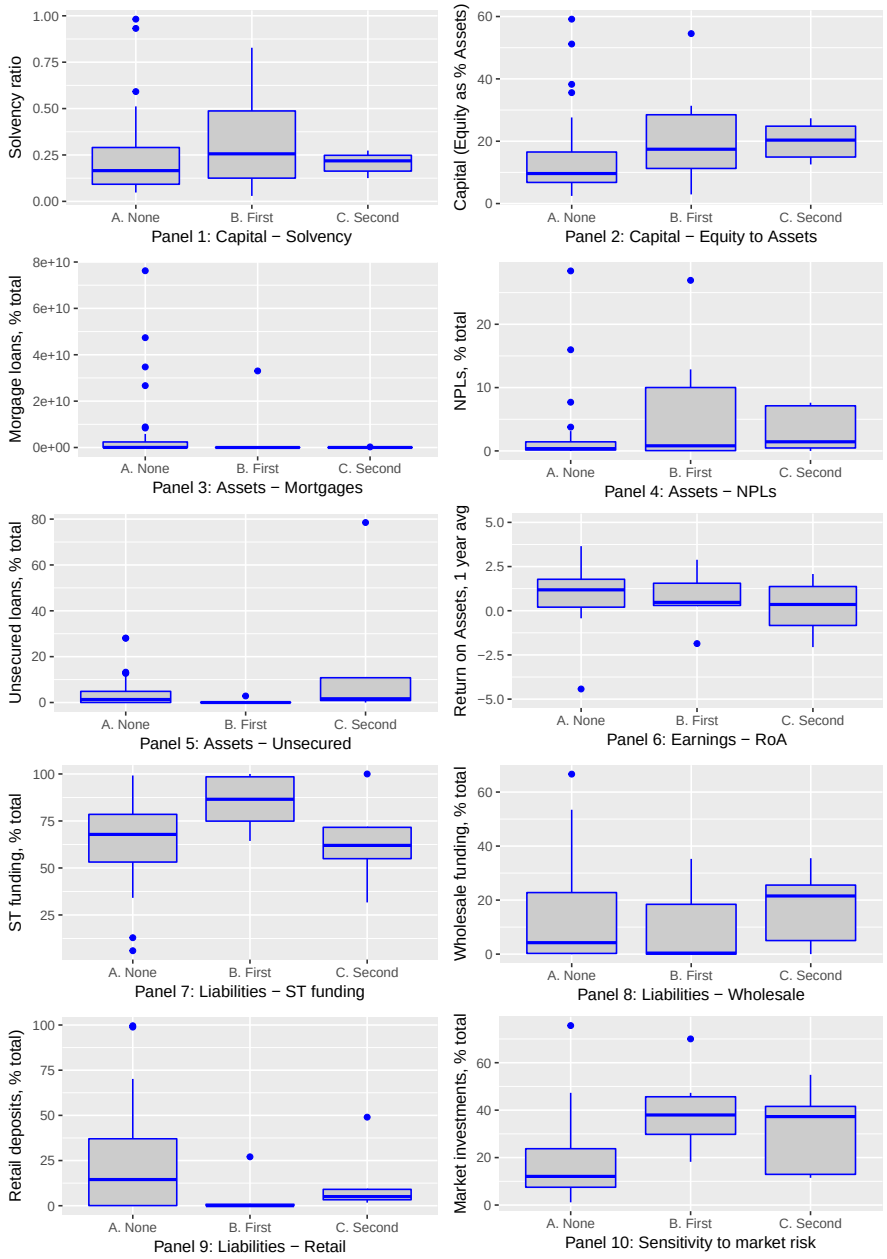


Figure 2.6: CAMELS analysis

Surviving and failing banks are compared using the CAMELS methodology. I find a statistical difference between failing and surviving banks in the following areas: (i) Capital, with failing banks having higher levels of capital, (ii) Liabilities, with failing banks having higher levels of short-term and wholesale funding; and (iii) Sensitivity to market risk, with failing banks being more exposed to financial instruments.

that the Saambou curatorship (and the Unifer/Unibank announcement) confirmed suspicions about small banks with large exposure to personal loans.

Specification (4) adds the role of exposure to financial instruments. Banks with large exposures to financial instruments are found to be more likely to fail. A number of different types of asset exposures were considered, but only 'Other Assets' was found to to be statistically significant ('Other assets' measures the extent of investments in financial instruments, financial assets and derivatives. It provides a market risk measure). A simple 'sanity check' – analysing the distribution of assets between failed banks and non-failed banks shows that there is no evidence of common exposures, i.e. the banks did not have similar loan portfolios.

Specification (5) tests the role of capital. A number of measures are used, and the role of simple unweighted assets to liabilities is reported. It is statistically significant and positive, in line with the results obtained in Figure 2.6. Interestingly, it appears that the coefficient on financial instruments is no longer statistically positive. However, other measures of capital (not reported here) show that financial instruments remain statistically significant. For example, when using the equity-to-debt ratio as a measure of capital, the share of financial instruments is still significant.

Table 2.6: Why did some banks fail? Logit regression results

	Dependent variable:					
	Probability of failure					
	(1)	(2)	(3)	(4)	(5)	(6)
Fin. sector liab (share)	0.096**	0.074**	0.060**	0.108**	0.121**	0.130**
	(0.040)	(0.034)	(0.030)	(0.046)	(0.050)	(0.058)
Liability growth	−0.042**		−0.031**	−0.043**	−0.049***	−0.048*
	(0.017)		(0.013)	(0.019)	(0.018)	(0.026)
Deposit growth		−0.017*				
		(0.009)				
ST liabilities (share)	0.113**	0.067**	0.051*	0.118*	0.104**	0.100
	(0.051)	(0.032)	(0.027)	(0.062)	(0.050)	(0.063)
Other assets (share)				0.049*		0.045
				(0.029)		(0.037)
Equity to Liabilites					0.110**	0.101*
					(0.056)	(0.056)
NPL ratio						0.007
						(0.111)
Constant	−10.571**	−7.085**	−5.169**	−12.560**	−12.513***	−13.564**
	(4.380)	(2.797)	(2.146)	(5.537)	(4.763)	(5.651)
Observations	45	45	46	45	45	45
Log Likelihood	−12.658	−16.442	−17.299	−10.946	−9.493	−8.380
Akaike Inf. Crit.	33.315	40.885	42.599	31.891	28.986	30.759

Note: *p<0.1; **p<0.05; ***p<0.01

This table presents the results of logistic regressions. The dependent variable takes the value of 1 if a bank 'fails' in the *twelve-month period* following the Saambou failure. The dependent variables take their values at the point that Saambou went into curatorship. Cadiz Bank is dropped due to poor data quality.

Predictive power

The predictive power of the model is presented in in three ways. First, the predicted probabilities for the year prior to the Saambou curatorship are presented in Figure 2.7. I present the average predicted probability for all banks and for the group of failed banks. It is notable that banks were weak *ex ante*. The Saambou failure appears to have triggered the failure of banks that were already weak due to fragile balance sheets (particularly an over reliance on short-term wholesale funding).

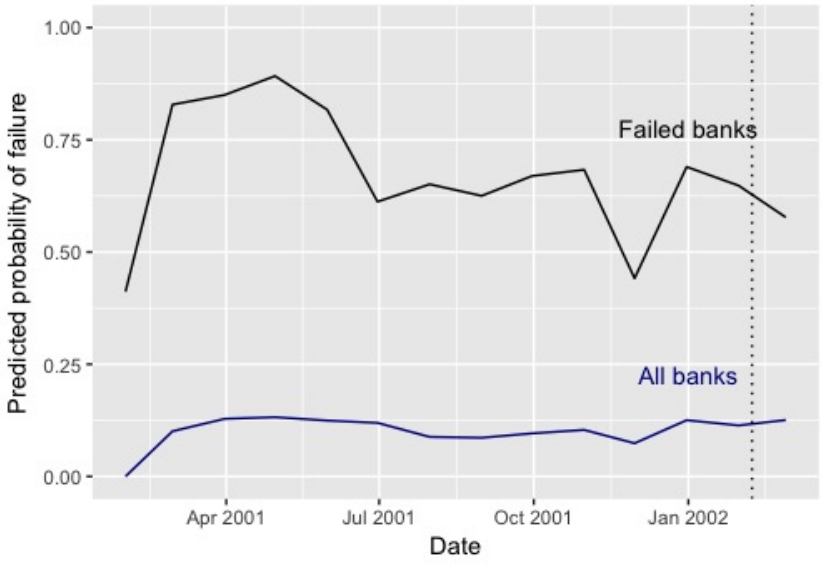


Figure 2.7: Probability of failure

The figure presents the probability of failure for failed banks and all banks. The date of the Saambou curatorship is indicated with a dashed line.

The second way to test for how accurate the model is to compare actual versus predicted failures. Four of the specifications in Table 2.6 are tested: specification 1, 2, 4 and 5. I exclude specification 3 as that included Saambou; and specification 6 as other statistical tests suggest the parameters are not significant. The predictive power of the model is presented in Table 2.7. Specification 5 emerges as the best from a fit perspective. 33 banks are classified correctly as 'Survive.' Two surviving

banks are classified as 'Fail.' Two banks that failed are predicted to survive, but 8 failed banks are correctly predicted to fail.[23]

Marginal effects

As discussed in section 2.4.2, the coefficients from logit models are not immediately interpretable, in contrast to the coefficients from linear regression. Marginal effects need to be calculated to obtain an estimate of the impact of a unit change in the dependent variable on the probability of the event.

I present the marginal effects in three ways. The first panel of Figure 2.9 presents the average marginal effect. Though marginal effects are non-linear an average effect can nevertheless be estimated by considering a unit change at mean of the dependent variable. Figure 2.8 presents the joint marginal effects, i.e. a simultaneous increase in both the percentage of financial liabilities and short-term liabilities.

Panels b and d in Figure 2.9 present the conditional expected values of the probability of failure given a set of different values for financial liabilities, as a proportion of total liabilities and as a ratio of short-term liabilities to long-term liabilities, respectively. Both these plots show the strong positive relationship between the probability of failure.

[23]Recall that twelve banks failed. The model only contains ten banks as Saambou is excluded, and Cadiz bank did not have sufficient data for the analysis.

Table 2.7: Goodness of fit estimates: logistic regression

Eq. 1

	P(Survive)	P(Fail)	
Survive	33	2	35
Fail	4	6	10
	37	8	

Eq. 4

	P(Survive)	P(Fail)	
Survive	33	2	35
Fail	3	7	10
	36	9	

Eq. 2

	P(Survive)	P(Fail)	
Survive	32	3	35
Fail	6	4	10
	38	7	

Eq. 5

	P(Survive)	P(Fail)	
Survive	33	2	35
Fail	2	8	10
	35	10	

Goodness of fit statistics	(1)	(2)	(3)	(4)	(5)	(6)
McFaddenR^2	0.47	0.31	0.32	0.54	0.60	0.65
R^2 ML	0.39	0.28	0.29	0.44	0.47	0.50
R^2 CU	0.60	0.43	0.44	0.67	0.72	0.76
Hosmer-Lemeshow C stat (p-value)	0.39	0.85	0.13	0.62	0.54	0.62
Hosmer-Lemeshow H stat (p-value)	0.29	0.29	0.76	0.85	0.74	0.85

Note:
This table presents a simple goodness of fit measure ('confusion matrix') for the logistic regressions in Table 2.6. The upper panel presents the number of predicted fails against the actual fails. This allows for the identification of Type 1 errors (false positive) and Type 2 errors (false negatives). The lower panel presents different pseudo-R^2 statistics for logistic regressions. Cadiz Bank was dropped due to data quality.

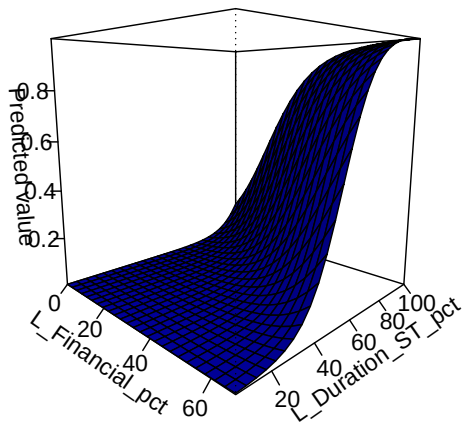
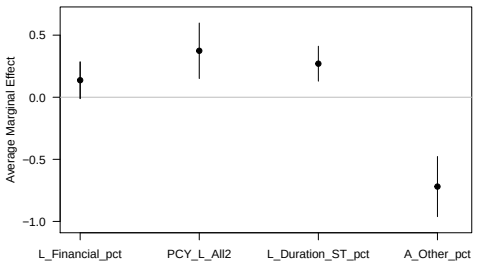
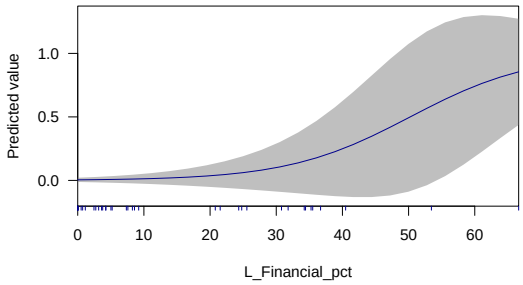


Figure 2.8: Joint marginal effects

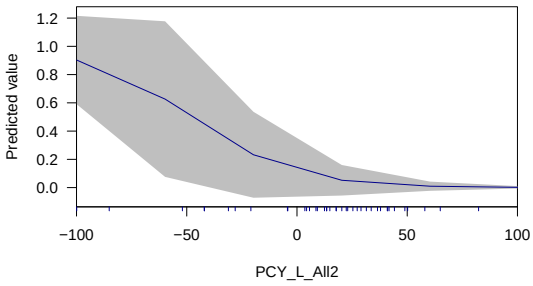
The probability of failure shown as a result of the joint effects of an increase in both financial and short-term liabilities as a percentage of total. The model predicts that banks with high percentages of short-term and financial liabilities were very likely to fail.



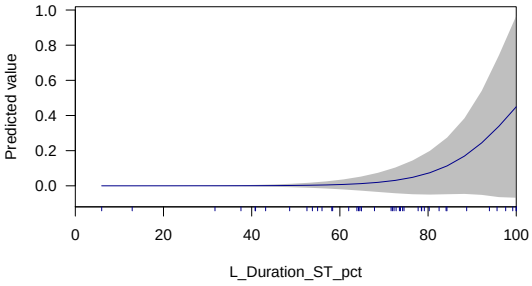
(a) Computed average marginal effects and standard error bands, derived from specification 4



(b) The probability of a run is an increasing function of the proportion of financial liabilities. Here we present the probability of failure as the conditional expected value given a locus of financial liabilities as a percentage of total liabilities. The conditional expected value is derived from the marginal effects model.



(c) The probability of a run is inversely related to deposit growth in the year prior to the Saambou failure.



(d) The probability of a run is an increasing function of the ratio of short-term liabilities to long-term liabilities.

Figure 2.9: Marginal effects

2.6.4 Why did some banks fail later than others?

The Cox proportional hazard model, detailed in the methodology section, incorporates the time to failure, and the results are presented in Table 2.8.

In specification (1), I test the impact of increased wholesale funding, deposit

growth, short-term funding, other assets and non-performing loans on the probability of failure at time t. It is immediately apparent that the same variables are statistically significant for both the logistic and Cox survivor methodologies. In particular, wholesale funding is significant and positive, indicating the probability of failure is increased (or probability of survival reduced).

Historical deposit growth is similarly statistically significant and negative, underscoring the finding that banks that were already experiencing outflows were more likely to fail, and that the failure of Saambou may only have accelerated the run, rather than precipitated it. Moreover, exposure to financial instruments is also statistically significant and positive, similarly to the logistic regression findings.

Although wholesale funding is statistically significant for the Cox regression results, short-term funding is not. The Cox regressions highlight that the structure of funding appears to create the difference in the time-to-failure. Both first and second wave banks were at risk of failure, with evidence that weak banks failed sooner if they had short-term funding. This is consistent with evidence from other countries; banks with short-term liabilties are more fragile when faced with an exogenous shock (Huang and Ratnovski, 2011).

The most notable difference between the logistic regression results and the Cox results is the role of non-performing loans. The Cox results show an increased likelihood of failure for banks with higher non-performing loans. I test for any correlation between non-performing loans and other variables, in case there is multicollinearity. In particular, the correlation is low between unweighted capital adequacy and non-performing loans (0.134), between exposure to financial instruments and non-performing loans (-.043), and between exposure to financial instruments and unweighted equity (0.191).

Table 2.8: How did time influence failure? Cox survivor analysis results

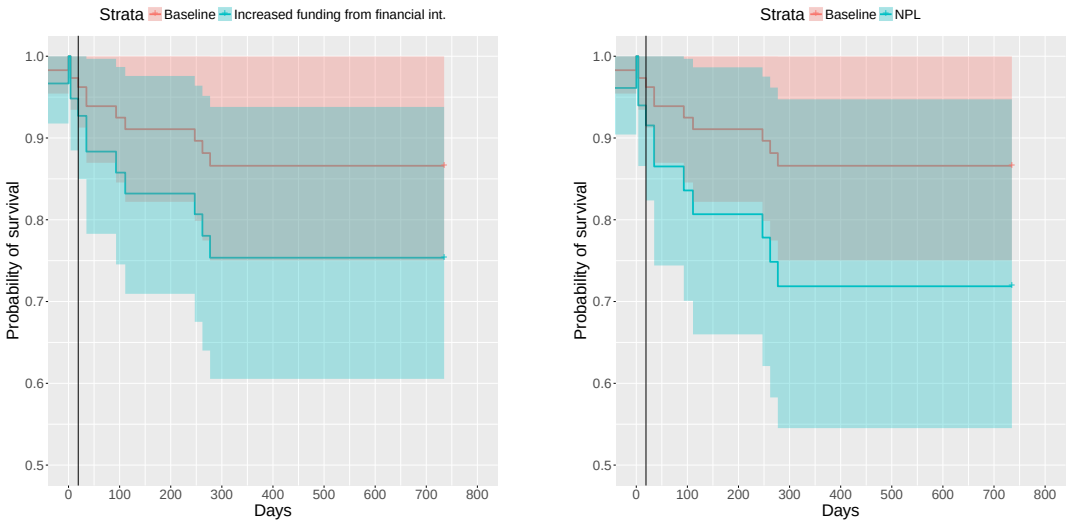
	Dependent variable:		
	Days_to_run2		
	(1)	(2)	(3)
Fin. sector liab (share)	0.097**	0.052**	0.105***
	(0.040)	(0.024)	(0.039)
Deposit growth	−0.017*		−0.017*
	(0.010)		(0.010)
ST liabilities (share)	0.022		
	(0.018)		
Other assets (share)	0.062**	0.054***	0.073***
	(0.029)	(0.018)	(0.027)
Equity to Liabilites	0.066**	0.039**	0.058**
	(0.027)	(0.019)	(0.024)
NPL ratio	0.140*	0.118**	0.153**
	(0.072)	(0.053)	(0.072)
Observations	45	46	45
R^2	0.453	0.294	0.431
Max. Possible R^2	0.807	0.830	0.807
Log Likelihood	−23.416	−32.819	−24.302
Wald Test	11.140* (df = 6)	11.630** (df = 4)	9.990* (df = 5)
LR Test	27.144*** (df = 6)	15.995*** (df = 4)	25.371*** (df = 5)
Score (Logrank) Test	23.301*** (df = 6)	16.916*** (df = 4)	21.902*** (df = 5)

Note: *p<0.1; **p<0.05; ***p<0.01

This table presents the results of Cox survivor analysis. The independent variable, time to failure, is calculated according to a hybrid approach discussed in the text. The dependent variables take their values at the point that Saambou went into curatorship. Cadiz Bank is dropped due to poor data quality.

Interpreting the results

Cox survivor analysis can be interpreted through survivor curves. These graphically present how estimated survival depends upon the value of a covariate of interest. Survivor curves plot the probability of survival of the mean bank, i.e. a bank with characteristics at the mean. A plot of the survival of a hypothetical alternate bank, with different characteristics can then be compared to that of the mean bank. Figure 2.10 shows the survival probability for a bank with increased wholesale funding and increased non-performing loans. The dramatic deterioration in survival probability is evident.



(a) Dynamic survival probability for a median bank: baseline and with a one standard deviation increase in wholesale funding

(b) Dynamic survival probability for a median bank: baseline and with a one standard deviation increase in non-performing loans

Figure 2.10: Survival plots

2.6.5 Machine learning: Random forest

The 'decision to run' can also be considered in terms of a decision tree. Figure 2.11 presents the decision tree graphically. A decision of 1 is a bank failure. At the first decision node, the question is 'Is short-term duration less than 100?' If *no*, then the right-hand branch is followed. Here, the algorithm shifts to the next decision node. The next question is 'Is the solvency ratio larger than or equal to 0.81?' If *yes*, then the left-hand node is followed, and the answer is 0, i.e. no failure. If *no*, then the right-hand branch is followed, and the answer is 1, i.e. a failure.

This may be interpreted as saying that banks short term funding ratio of 100 per cent will fail if their solvency ratios are less than 81 per cent. If *yes*, then further questions are asked about the asset quality of the bank, with final decisions of either 'fail' or 'survive.'

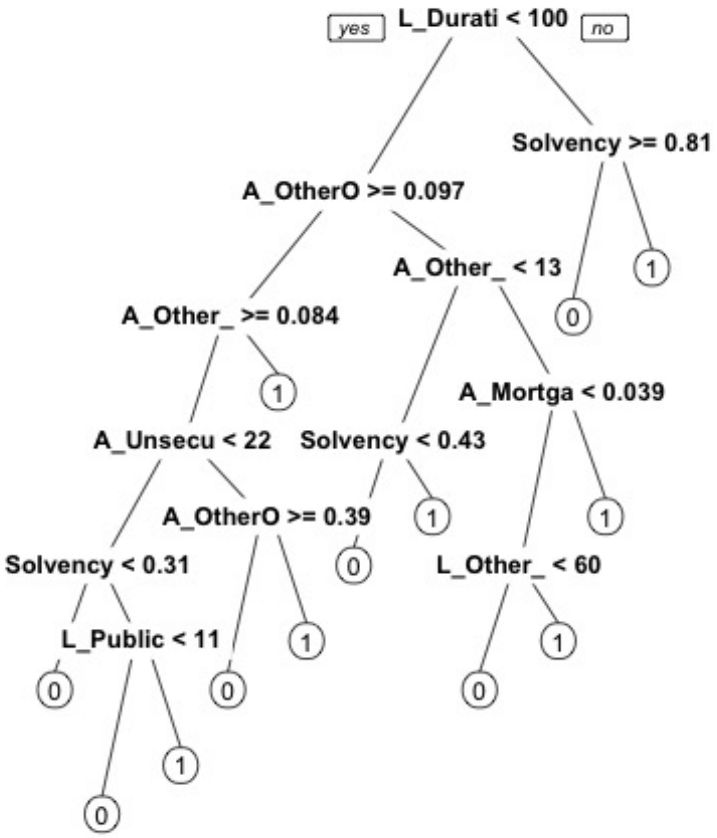


Figure 2.11: Decision tree

The random forest approach has the advantage of ordering variables in terms of importance, similar in some ways to principal components analysis. In Figure 2.12, I generate a variable importance plot from the random forest model above.

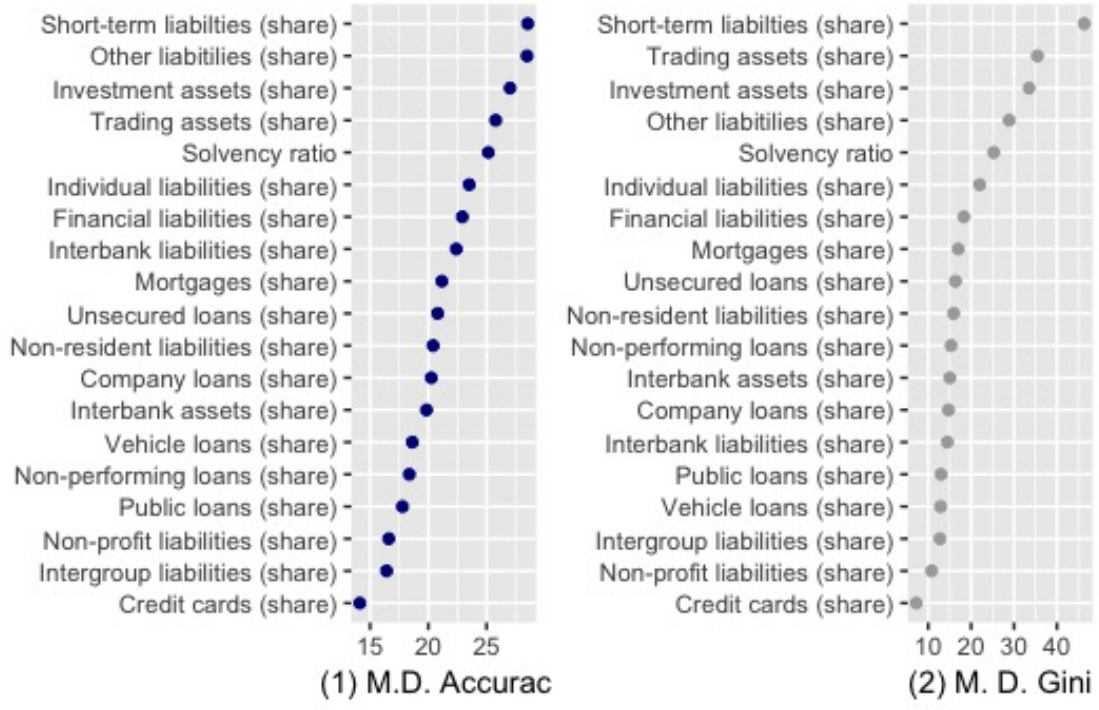


Figure 2.12: Variable importance plot

This presents the variables used in the random forest model in order of relative importance to the decision. Two tests are used – Mean Decrease Accuracy and Mean Decrease Gini. The former measures the impact of excluding a variable on the accuracy of the model. The latter is a related measure that technically measures the impact of the variable on the homogeneity of the nodes and leaves. The most important variable is short-term liabilities.

It shows a somewhat different outcome from the analysis using traditional econometric techniques. The percentage of short-term funding is still the dominant driver of the results. However, the proportion of 'Other Assets' is the second most important determinant of failure. (Recall that 'Other Assets' are financial instruments. Banks with these assets are more typically investment banks). In the CAMELS analysis, this was also noted (see Panel 10 of Figure 2.6, and the discussion in section 2.6.2). In the logistic regression, specification 4, this variable was statistically significant, but only at the 10 per cent level. Moreover, the odds ratio was smaller than the financial sector liabilities odds ratio.

This shows the power of alternative machine-learning techniques to bring out

data features not necessarily captured by traditional econometrics, a point also made by Varian (2014).

2.6.6 Can these results predict other failures?

The results in this study are particular to the 2002/3 period. The model performed relatively well at predicting in-sample failures (recall Figure 2.7 and Table 2.7). However, it is a worthwhile experiment to see if the results can accurately predict others bank failures, particularly the 2014 failure of African Bank (discussed in Chapter 4) and the 2018 failure of VBS Mutual Bank.

Data points from African Bank and VBS Mutual Bank are placed into the specification 4 of the logistic regressions reported above. I use the data from their balance sheet in the year prior to failure to generate the predicted probability of failure. In the case of African Bank, it is a years' worth of data starting in August 2013; and in VBS Mutual Bank, a year of data from February 2017. The results are plotted in Figure 2.13. It shows that the model is quite accurate at predicting even completely out of sample failures (both failures were characterised by banks with high levels of wholesale and short-term funding, which deteriorated as the failure neared).

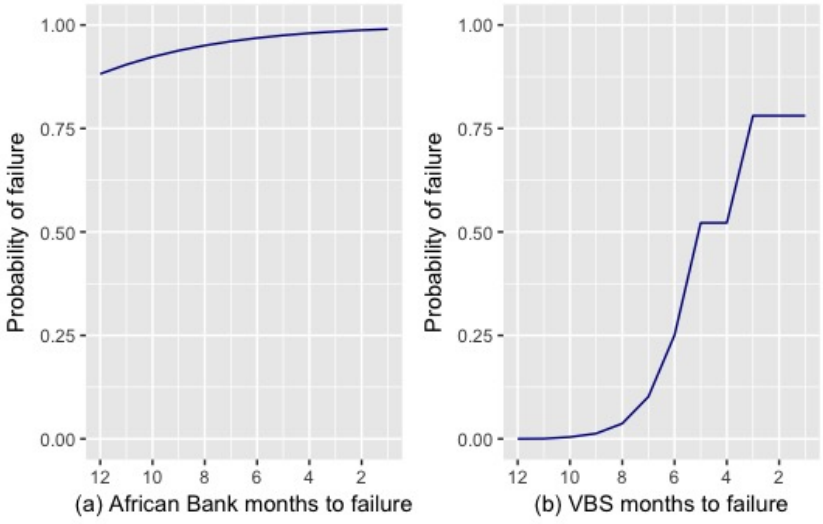


Figure 2.13: Predicted failure probabilities

The balance sheet data for African Bank (Panel a) and VBS Mutual Bank (Panel b) for the twelve months ahead of the failure is placed into the model.

2.6.7 Long-run effect of the Saambou collapse

The consolidation substantially increased concentration in the banking system. Before the crisis, BOE had a market share of 13.1 per cent of the mortgage market, and Saambou had a 3.3 per cent share. The crisis reduced the competitiveness of the mortgage market. Reviewing the data highlights another feature of the episode. In a closed system (i.e. a system with a sovereign currency and currency convertibility rules such as South Africa), liquidity cannot move outside of the system. This is partially due to currency convertibility rules. Only Authorised Dealers (ADs) can convert rand into other currencies. These ADs must, in turn, be registered South African banks. The effect is that rand liquidity circulates between ADs. This is quite different from a run on Greek banks, for example. Any bank in the euro area can accept Euros. Thus the liquidity of the euro can move from Greece to Germany. Conversely, in a closed system, a run on one bank must reflect as an inflow into another, or alternatively as an increase in notes and

coins.[24]

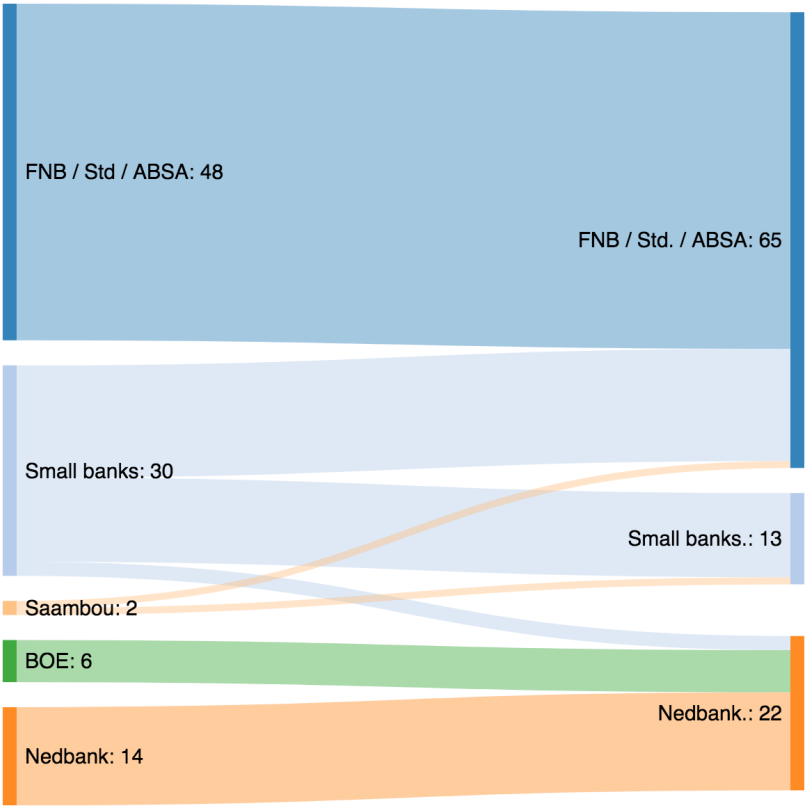


Figure 2.14: Market share: Before and after consolidation

Market share of 'other banks' fell from 22 per cent to 12 per cent. BOE was wholly subsumed into Nedbank, and Saambou was split between FNB (Homeloans) and African Bank (personal loans).

The experience in South Africa was indeed that liability holders reallocated their deposits and there was a a discernible 'flight to quality'. Simply put, a set of banks experienced substantial inflows. While more than four banks experienced inflows, the majority of flows went to four. These banks are now known as the 'Big Four' because of their dominance, but prior to the episode they were not as

[24]The increase in notes and coins is a feature of episodes in other countries, particularly in the National Bank Period and failures in less-developed countries.

significant. In January 2002, prior to the curatorship, these four accounted for 62.4 per cent of assets. By January 2003, they accounted for 88.4 per cent of assets.

The most notable 'winner' from the episode was Nedbank, which saw its market share rise from 14.0 per cent to 22.3 per cent, almost entirely due to its purchase of BOE. Figure 2.14 shows the change in market share during this time. The market share shift is most notable at product level, with the crisis leaving a substantial concentration in home loans.

The second 'winner' was African Bank, which was at the time a small unsecured lending business. It purchased the Saambou unsecured lending book at a discount, and this formed the basis of its growth strategy over the next few years.

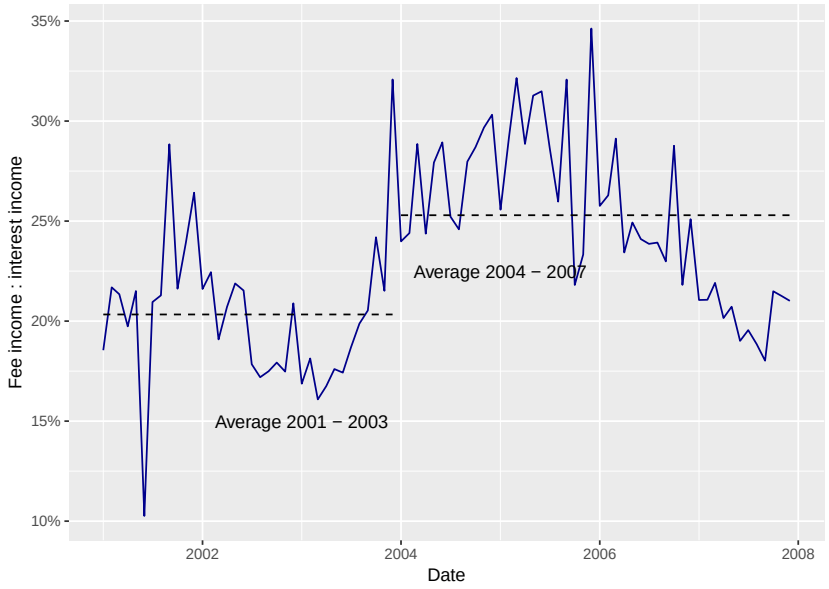


Figure 2.15: Fee income

There was an approximately 5 percentage point increase in the ratio of fee income to interest income, suggesting substantial pricing power after the crisis.

Source: Reserve Bank Banking Supervision Department.

The resultant concentration of the system may have had the inadvertent effect of increasing bank profitability and market power. Some of the literature (Allen

and Gale, 2004; Sinclair and Farrell, 2017) has argued that there is an inherent competition stability trade-off. That is that banks in more concentrated, oligopolistic systems may be 'safer' because the incentives to take on risk are reduced. In Figure 2.15, this comes to the fore. Between 2001 and 2003, the ratio of fee income to interest income was 20 per cent. However, following the consolidation, the ratio was just over 25 per cent. This suggests that the consolidation led to pricing power which manifest in higher fees being charged.

2.7 The authorities' response

The curatorship was announced on Monday, 4 February 2002. The pressures on BOE and the other banks began immediately. A further statement made on Thursday, 14 February outlined some of the rationale for the decision (Minister of Finance, 2002). It noted that:

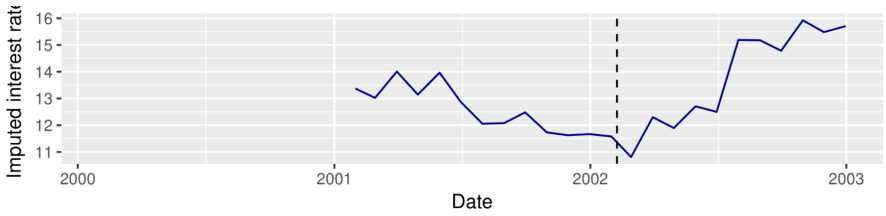
> In examining options, we firmly held the view that to commit Government financial assistance to SAAMBOU Bank would not be prudent as there was no guarantee that those funds would either restore confidence or not be utilised to fund further large net outflows from depositors funds out of the bank.

This statement did not restore confidence to the banking system – quite the opposite as the perception emerged that the authorities would not provide any support to small banks. The situation at BOE deteriorated and all its assets were fully guaranteed, albeit a full month later on 14 March 2002.

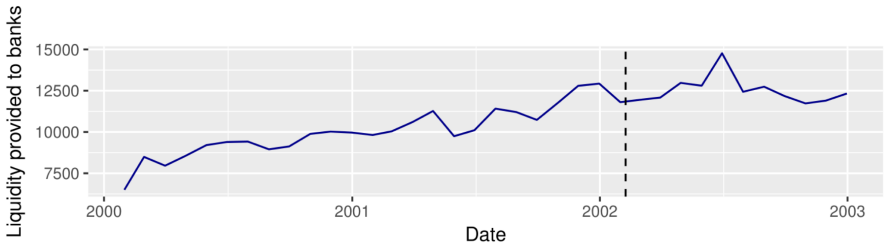
This echoes the inappropriate response by the US Federal Reserve as the Great Depression unfolded, and it is worth repeating this paragraph from Friedman (1968):

> [Money supply] fell not because there were no willing borrowers – not because the horse would not drink. It fell because the Federal Reserve System forced or permitted a sharp reduction in the monetary base, because it failed to exercise the responsibilities assigned to it in the Federal Reserve Act to provide liquidity to the banking system.

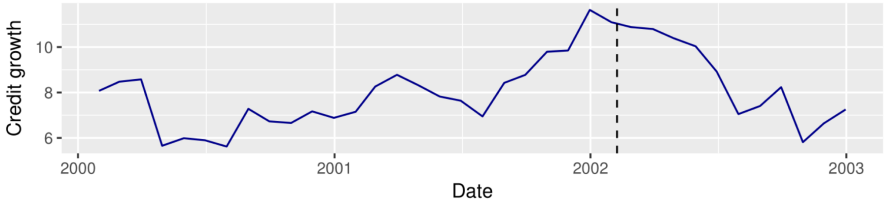
Figure 2.16 demonstrates that the authorities did not intervene heavily in the market to provide liquidity or ease monetary conditions. Indeed, the repo rate was raised by 400 bps, from 9.5 per cent in December 2001 to 13.5 per cent in September 2002, as the Reserve Bank aimed to dampen the second-round effects of the sharp depreciation in the rand experienced during late 2001.



(a) Imputed interest rates rose over the course of the crisis, mainly due to repo rate increases. In total the repo rate was raised by 400 bps, from 9.5 per cent in December 2001 to 13.5 per cent in September 2002. Also see Figure 2.3.



(b) Some additional liquidity was provided to the system, with a small peak in June 2002. However, this liquidity was not widely provided.



(c) Credit growth slowed significantly during the course of the crisis.

Figure 2.16: Policy response

The central bank did not intervene significantly to provide liquidity or support to the banking sector

Source: South African Reserve Bank, monthly data

Institutionally, the way in which the Reserve Bank considered the 2002/3 crisis is borne out by its own subsequent analysis. There is extensive analysis of the crisis in the Bank Supervision Annual Report. However, it is not mentioned in the Monetary Policy Review, nor in the minutes of the monetary policy committee issued on 14 March 2002, in the middle of the crisis. For monetary policy purposes, the authorities appear to have judged that the contraction in credit growth was not due to the crisis. This is despite evidence that the effective interest rate rose and the net interest margin rose, suggesting tighter monetary policy conditions. The credit contraction was in corporate lending, and many of the banks that failed were corporate lenders. Indeed, at its 14 March 2002 meeting, the monetary policy committee raised interest rates by 100 bps. There is, however, a long discussion of the crisis in the 2002 Banking Supervision Annual Report (Registrar of Banks, 2002), produced by a different department in the Reserve Bank. In contrast, the supervision annual report does not discuss credit trends, but rather discusses growth in bank assets. It also notes that some banks received liquidity support, but does not disclose which. In the monthly banking statistics, none of the banks disclose receiving liquidity.

There was substantial engagement between the then Minister, Trevor Manuel and the Reserve Bank about the appropriate course of action. In her biography of Manuel, Green (2012, 506) outlines the disagreement between the Treasury and Reserve Bank. She notes the discovery of a letter from the financial director of Saambou, addressed to the auditors of the bank and to Christo Wiese, the Registrar of Banks. On the basis of the letter, the Treasury concluded that Saambou was insolvent and that liquidity provision would not be an appropriate course of action. The Registrar subsequently indicated that he thought this was the incorrect decision, and that the decision may have led to the run. His summary of the Saambou failure in the Bank Supervision Department's Annual Report (Registrar of Banks, 2002) was also read to imply that he disagreed with the decision, and interviews he gave to the press underlined his view. This evidently led to him being asked to take early retirement – see Mittner (2003*b*).

2.8 Conclusion

The 2002/3 banking crisis presents an opportunity to better understand bank failures, and draw lessons for the system of financial regulation. The failure was unique internationally – at the time there was little interconnectedness between the banks, South Africa did not have deposit insurance, and there was extensive *ex ante* information available to depositors.

The chapter argues that the response of the authorities was inappropriate, and highlighted some coordination weaknesses (between and within institutions). In the year leading up to the small bank crisis, unsecured lending grew by 26.7 per cent, and overall credit growth averaged 9.5 per cent. The central bank, however, reduced the benchmark policy rate. Moreover, the exchange rate depreciated significantly. When the first bank failed in February 2002, the authorities intervened only tentatively – providing a deposit guarantee to one of the large banks. Contagion quickly spread, and faced with a generalised loss of confidence amongst a group of small banks, the authorities did not provide unlimited liquidity support.

The response was within the framework of the 'Greenspan Standard'. In the year leading up to the failure, the central bank did not intervene to slow credit growth, preferring a 'clean, not lean'. But when the crisis hit, the Reserve Bank progressively increased the overnight policy rate during the course of the crisis, creating potentially greater liquidity pressures. The episode shows the need for a coordinating framework for different functions of the central bank (liquidity provision, monetary policy formulation and banking supervision).

In the next chapter, I outline the approach taken over the years leading into the global financial crisis. Lessons from the small bank crisis appear to have been learnt, and the response was substantially more sophisticated.

Chapter 3

Why did South Africa not experience a banking crisis in 2008?

In contrast to many other jurisdictions, South Africa did not experience a banking failure during the 2008 global financial crisis. In the years prior to the crisis, the banking supervisor increased capital adequacy ratios, due to concerns about rapid growth in credit extension and rising asset prices. I extend the government's main forecasting and policy model to show that this dampened credit and the financial cycle, and reduced the risk of a financial crisis. The chapter shows the importance of a monetary and macroprudential policy decision making framework.

3.1 Introduction

South Africa did not experience a significant bank failure during the global financial crisis period. A number of explanations have been proposed for this, including a budget surplus leading into the crisis, a credible monetary policy framework, and a sound bank regulatory framework (International Monetary Fund, 2008; Gilbert et al., 2009; Manuel, 2009; National Treasury, 2011; Kganyago, 2012). Moreover, as noted at the end of chapter 2, the consolidation of the banking system created a more oligopolistic system. Banks appear to have more pricing power, allowing them a more diverse revenue stream, and less incentive to take on risk. This reduction in competition may have financial stability benefits (Allen and Gale, 2004).

This chapter focusses on one aspect of the regulatory response, and evaluates

the economic and financial effects of altering bank capital requirements in the lead up to the global financial crisis. This also provides context to policy debate on the use of proactive macroprudential policy tools.

In summary, the chapter finds that, although the two policy levers are complementary and not equivalent, a 1 percentage point shock to the capital adequacy ratio is estimated to have similar effects on credit extension to an interest-rate shock of between 0.3 and 0.4 percentage points. It has limited effects on inflation and cannot substitute for a monetary policy tool. However, it is arguably most useful in increasing financial resilience in small open economies facing credit shocks driven by capital flows. It is important to ensure that macroprudential and interest rate policy levers are used in a complementary manner to ensure that they do not conflict.

3.2 The institutional setting

As the effects of the 2002/3 small bank crisis receded, credit growth rebounded. South Africa benefited from the global 'Great Moderation', and between 2002 and 2007, South Africa experienced strong economic growth, low inflation, credit growth, and rapid asset price increases. This growth, however, was mainly consumption led, and supported by an increase in credit extension. As highlighted in Table 3.1, during the 2002 to 2007 period, output expanded by 4.6 per cent a year on average, and consumer price inflation remained comfortably within the 3 to 6 per cent target range. Private sector credit extension growth accelerated to average 17.5 per cent a year, and house price growth averaged 20.2 per cent a year.

Against the backdrop of strong economic growth, fiscal policy was broadly countercyclical. The fiscal deficit was 2.3 per cent in the fiscal year 2003/4. By 2006/7 this deficit had turned to a surplus of 1 per cent of GDP, an improvement of 3.3 percentage points in the budget balance (International Monetary Fund, 2008).

The South African banking supervisor became increasingly concerned with accelerating credit growth. Changes to required capital adequacy levels can be linked to three separate instances of regulatory intervention, with the dates indicated in Figure 3.1: (1) On 22 April 2003, Bank Supervision Circular 8/2003 made a number of changes to the quality of capital, which had the overall implication of

Table 3.1: Selected macroeconomic variables, 1996 – 2012 (%)

	Output growth†	Household consumption growth†	Consumer prices increase	Private sector credit extension growth*	House price growth*
1996 – 2001	2.8	3.2	6.5	13.3	10.6
2002 – 2007	4.6	5.4	4.2	17.5	20.2
2007 – 2012	2.7	3.0	6.5	11.0	4.6

Source: South African Reserve Bank, ABSA House Price index
† in real terms * in nominal terms

raising the quantity of capital held.

In particular, the treatment of preference shares was altered, which narrowed the definition of regulatory capital. (2) On 20 February 2004, Bank Supervision Circular 1/2004 set out the consultation on the implementation of Basel II. This circular made it clear that banks would have to increase capital ahead of the full implementation of Basel II on 1 January 2007. Moreover, this circular highlighted that capital levels would be within the Registrar's discretion[1]; and (3) on 13 December 2004, Circular 19/2004 made changes to calculations of quality of capital. The effective date was January 2006. The changes included the revised definitions that were required in terms of Basel III and clarified that at least 60 per cent of the minimum required capital adequacy ratio had to consist of primary share capital, without any reliance on hybrid debt instruments.

The overall effect of these circulars was that overall capital adequacy levels rose from 11.96 per cent in March 2003 to 13.67 per cent in March 2005, i.e. by a cumulative 171 bps. This exogenous imposition of an increased capital adequacy requirement provides a unique opportunity to test the impact on the broader economy.

[1] A detailed discussion of these changes can be found from page 26 of the Circular.

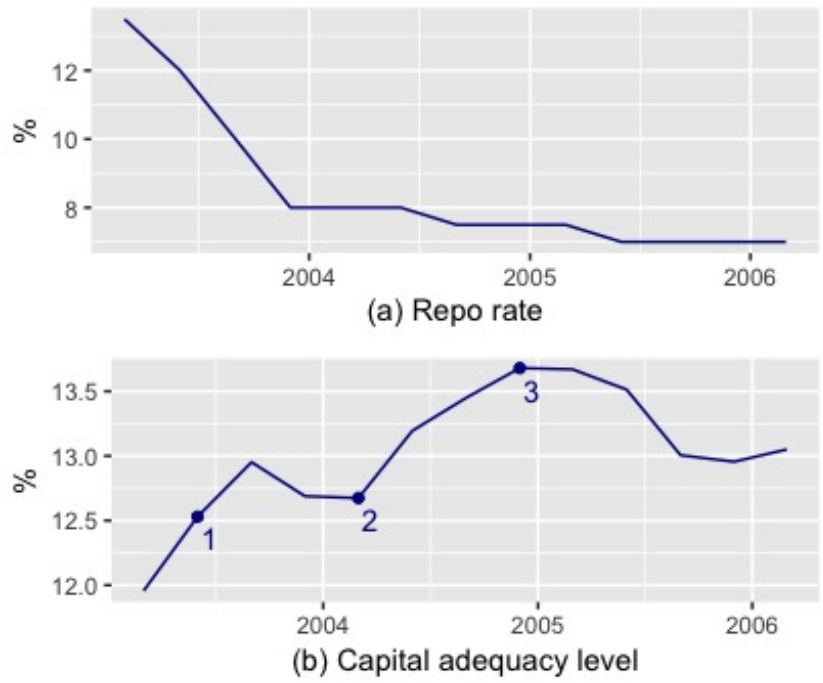


Figure 3.1: Repo rate and capital adequacy (%)

In the years leading up to the global financial crisis, the monetary policy committee reduced the repo rate (*upper panel*). At the same time, the Registrar of Banks increased capital adequacy levels through three circulars (*lower panel*).

3.3 Related literature

This chapter contributes to a growing empirical literature on the use of tools beyond interest rates to manage economic fluctuations and counteract financial system risks, typically in the context of an inflation-targeting framework.[2] Blanchard et al. (2010) summarise the view that 'the policy rate is a poor tool to deal

[2]There is a well-established literature on standard economic models that include bank balance sheets (Bernanke and Blinder, 1988, 1992), or on extensions that focus on the bank-lending channel of monetary policy, particularly the interaction between monetary policy and the external finance premium (Bernanke and Gertler, 1995), or on how monetary policy affects bank balance sheets (Kashyap and Stein, 1995; Bernanke et al., 1999; Kiyotaki and Moore, 1997) There was also a theoretical understanding on interaction between low inflation and the build-up of financial imbalances (Borio and Lowe, 2002).

with excess leverage, excessive risk taking or apparent deviations of asset prices from fundamentals.'

There are, however, conceptual difficulties with extending the central bank's toolkit beyond interest-rate policy. The proposed candidates for policy levers are so-called 'macroprudential' tools, which are bank supervision ('microprudential') tools applied to broader systemic goals.[3]

Theoretically, there are some difficulties with applying microprudential tools for broader financial stability goals. The Modigliani-Miller theorem states that cost of funding is independent of the type of funding. It follows that, theoretically, a change in the balance of equity versus debt funding should have no impact on banks funding costs or behaviour. However, Miller (1995) himself finds empirically that Modigliani-Miller does not always hold true for banks.

The empirical literature is relatively mixed on the efficacy of changes to these requirements. In a pre-crisis study, Aikman and Paustian (2006) shows an opposite effect – well capitalised banks may have cheaper funding. Other studies show limited impacts – for example Saurina (2009) finds that the dynamic provisioning system adopted by the regulator in Spain in 2000 had little influence on stopping the credit and real-estate boom (but did note that it may have dampened the effects of the crisis). Dell'Ariccia et al. (2011) find that the use of increased capital requirements and/or risk weights on types of real-estate loans are either unsuccessful (Bulgaria, Croatia, Estonia and the Ukraine) or a 'partial success' (Poland).

Another group of studies show an effect of capital on economic and financial outcomes. Mésonnier and Stevanovic (2013); Corbae and D'Erasmo (2014); De Resende et al. (2016) and Mésonnier and Stevanovic (2017), show that an increase in the capital-to-assets ratio reduces lending. In particular, Corbae and D'Erasmo (2014) develop a theoretical model with large dominant banks and smaller competitive fringe banks to show that a 2 percentage point increase in capital requirements (a 50 per cent rise from 4 per cent to 6 per cent) causes interest rates to rise by 50 basis points.

[3]For an overview of the origins of the term 'macroprudential' see Clement (2010), while for comprehensive literature reviews of the subject see Galati and Moessner (2013), Turner (2012), or Lim et al. (2011).

A set of cross-country studies show that macroprudential policy measures are relatively successful at reducing credit growth, particularly household credit (Claessens et al., 2014; Cerutti et al., 2015). It is noted that emerging markets use macroprudential policies more frequently, and that these policies are indeed more effective in these jurisdictions. This is, in part, because their financial systems are more closed, may be more prone to destabilising credit booms due to fixed exchange rate, expansionary macroeconomic policy and low-quality banking supervision .

There is a small, but growing South African literature. The jurisdiction is included in some of the panel regressions in Cerutti et al. (2015). Moreover, Farrell (2016) calibrates potential countercyclical capital buffers using the Basel committee guidance, concluding that a mechanical application may not be best for the jurisdiction. Grobler and Smit (2015) include capital adequacy, liquidity and financial sector neutral estimates of the output gap within a larger macroeconomic model, and conclude that these have an impact on lending to households, not dissimilar to results obtained in the empirical and theoretical international literature. Liu and Molise (2018) consider the implications of introducing Basel 3. Using a dynamic stochastic general equilibrium model (DSGE), they include an endogenous macroprudential authority that responds to asset prices and interest rate dislocations. They provide evidence that there are countercyclical effects from the regulatory authorities raising capital requirements response to changes in credit and output.

3.4 Methodology

3.4.1 The model

This chapter extends the National Treasury Quarterly Model, the main government policy model. The model has a theoretical basis in the IS-LM framework, which is the approach taken in many of the similar studies, including the Bank of International Settlements Macroeconomic Assessment Group study. Alternative approaches were considered, including a vector autoregression (VAR), vector-error correction model (VECM) or a DSGE. These approaches have costs and benefits. In particular, small models do not cover all possible interlinkages. As will be

discussed, smaller models do not necessarily include open economy dynamics. The DSGE literature on the topic is still in its early stages, with notable contributions from Curdia and Woodford (2010) and Liu and Molise (2018). Moreover, the model has a carefully calibrated and tested monetary-transmission mechanism, and ensuring that this channel is correct is crucial for the analysis.

The model shares many similarities with several other models, both internationally (e.g. the Federal Reserve Board's model (FRB-US) and the Bank of England Quarterly Model) and in South Africa (e.g. the South African Reserve Bank Model described in Smal et al. (2007); De Jager et al. (2015) and the Stellenbosch Bureau of Economic Research model summarised in Grobler and Smit (2015)).

A key weakness of structural models of this type is the well-known Lucas Jr (1976) critique: estimated parameters may not be robust to policy actions. This problem can to some extent be overcome by estimating deep structural parameters, a task Fuhrer and Estrella (1999) call 'extraordinarily daunting', or relying on theoretically-specified models with calibrated parameters. Two notable South African examples of such theoretically-grounded models are Jooste and Marinkov (2012) and De Jager et al. (2015).

While the Lucas critique should be considered, it comes with an important caveat that means it is not necessarily fatal. Fuhrer and Estrella (1999) note that backward-looking fitted models produce more stable results than forward-looking specified models, possibly because expectations are formed on an adaptive rather than rational basis. Moreover, models such as these, particularly the Federal Reserve model, are widely used for policy analysis despite potential Lucas-critique weaknesses. Indeed, these models are not expositional models but rather the workhorses of a policy environment, with their results used as input into fiscal and monetary policy decision making in their institutions (Tulip, 2011).

The variant of the model used in this analysis is in this tradition, and is a relatively standard large-scale IS-LM model containing a set of estimated equations. At the heart of the model is a demand function (equation 3.1 below), which states that in line with the standard approach demand y is function of income, y_d, interest rates, i, government spending, g, and external factors, s. Then a supply function (equation 3.2) for y^* specifies that supply is a Cobb-Douglas type combination of technology, capital stock and labour. These two balance through

prices and interest rates (equation 3.3 and 3.4), such that prices are anchored by expectations, p^e, when there is a positive output gap, $y - y^*$, or when wages rise, w. The policy rate, i is specified as a Taylor rule, and is a function of price expectations, the output gap and a measure of the natural interest rate, in this case given as the global risk-free rate, i^*, and the risk premium, i_r.

$$y = f(y_d, i, g, s) \tag{3.1}$$
$$y^* = f(A, K, L) \tag{3.2}$$
$$p = f(p^e, \frac{wL}{y}, y - y^*) \tag{3.3}$$
$$i = f(p^e, y - y^*, i^* + i_r) \tag{3.4}$$

This is a high-level structure of the model, and in practice the model is a disaggregated version of the scheme laid out above. For example, y is disaggregated into its constituent components, viz. consumption expenditure, residential investment, non-residential investment, government consumption expenditure, government investment expenditure, exports and imports and so forth. Moreover, there is an implicit yield curve – the ten-year yield is a function of the policy rate and the fiscal position. This ensures that the model is internally consistent– for example, an increase in government consumption expenditure increases demand but also raises the fiscal deficit and long-run borrowing costs.

3.4.2 Introducing capital adequacy as a policy variable

Capital adequacy is introduced into the empirical model based on the theoretical contribution of Cecchetti and Kohler (2012),[4] and the extension proposed by Du Plessis et al. (2011), where two distinct short-term interest rates are included: ρ, the rate at which banks lend, and i, the interest rate on bonds.

Cecchetti and Kohler (2012) extend the IS-LM-CC intuition and more extensively specify the factors that may influence ρ, the rate at which banks lend to the

[4]Their contribution is in turn based on Bernanke and Blinder (1988, 1992), where the rate at which banks lend, ρ, is a function of not only the policy rate, i, but also demand (y) and the level of reserves (R), $\rho = \varphi(i_+, y_+, R_-)$

economy and that is associated with equilibrium in output and inflation. To see the derivation, first, assume that aggregate demand y^d is given by:

$$y^d = -\alpha(\rho - \pi^e) - \beta(i - \pi^e) - \delta\pi + \eta \tag{3.5}$$

where π^e is expected inflation, π is current inflation and η a white noise random variable, and the parameters are α, β and δ. The short-term rate i is set by policy makers, while the lending rate is determined by equilibrium in the lending market.

Aggregate supply (y^s) is specified in a relatively simple fashion as a function of expected and unexpected inflation and an error term:

$$y^s = \gamma(\pi - \pi^e) + \varepsilon \tag{3.6}$$

Loan supply is given by assuming that banks are constrained by the capital that they hold, such that:

$$L^S = -\kappa.k + \tau.by \tag{3.7}$$

where k is the capital requirement and y is output, with κ the parameter for the capital requirement, and b is a ratio of bank capital to real output (assuming bank capital rises as output rises), such that the overall level of bank capital is by. The parameter τ reflects sensitivity of loan supply to bank capital (by).

Loan demand is, in a modified version of the IS-LM-CC derivation above, given as:

$$L^d = -\phi(\rho - \pi^e) + \omega y \tag{3.8}$$

Equilibrium conditions are obtained by setting $y^s = y^d = y$ and $L^d = L^S$, and assuming rational expections, expected inflation can be normalized to zero.

From the equilibrium conditions, the derivation for the equilibrium lending rate is given as:

$$\rho^* = \left(\frac{\delta(\omega - b\tau)}{A}\right)\varepsilon + \left(\frac{\gamma(\omega - b\tau)}{A}\right)\eta + \left(\frac{\beta\gamma(\omega - b\tau)}{A}\right)i + \left(\frac{\kappa(\gamma + \delta)}{A}\right)k \tag{3.9}$$

In summary, ρ^* is function of white noise error ε, a transitory demand shock η, the rate on bonds, i, and the capital requirement imposed on banks, k.

3.4.3 Calculating a series for ρ

In this analysis, we wish to distinguish econometrically between ρ, the effective lending rate, and i, the policy rate. Fundamentally, the thesis is that these may diverge over time. Calculating the value of ρ thus provides an important insight into how relatively tight or loose monetary policy conditions are. In this paper, the value of ρ is approximated as an imputed interest rate, following Rice and Ors (2006) and Curdia and Woodford (2010):

$$\rho = \frac{I}{L} \tag{3.10}$$

where I is the interest income earned on the outstanding stock of loans in the banking system, L. [5]

3.4.4 Econometric technique

Each equation is estimated using a single equation co-integration technique (Engle and Granger, 1987; Wickens and Breusch, 1988; Pesaran and Smith, 1995). This involves the simultaneous estimation of the long- and short-run parameters within a unrestricted error correction autoregressive distributed lag model, $ARDL(p, q)$. In this approach, each equation is estimated as:

$$\Delta y_t = \phi \eta_{t-1} \sum_{j=1}^{p-1} \lambda_j \Delta y_{t-1} + \sum_{j=0}^{q-1} \delta_j' \Delta x_{t-j} + \mu_0 + \varepsilon \tag{3.11}$$

[5] This approach to calculating the series has both advantages and disadvantages. The major advantage is that it is easy to calculate, particularly across multiple asset classes and loan books. This provides information in terms of differentiated interest rates across different clients, and hence the interest rate on different asset classes. The major disadvantage is that it is the average interest income across the book, not the marginal interest income. Put another way, it simply measures total interest income, even on loans originated a number of years previously. It does not reflect the rate of interest on new lending, nor does it give insight into how much income has not been received (e.g. from non-performing loans). However, most loans in South Africa are variable rate, and so the average rate and the marginal rate tend to be the same. Finally, for the period this paper covers, non-performing loans were stable.

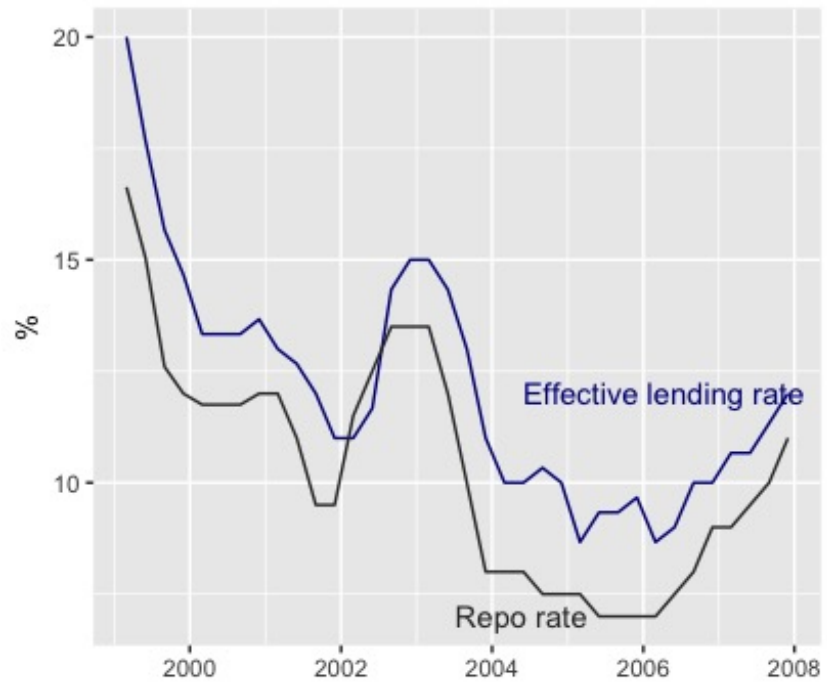


Figure 3.2: Effective lending rate and the repo rate (2002 – 2007)

The effective lending rate, ρ and the overnight policy rate (repo) track each other, except notably from 2004 onward, where the effective lending rate rose relative to the repo rate.

where $\eta_i = y_t - \theta' \boldsymbol{x_t}$ and t denotes time periods, y_t is a scalar dependent variable, x_t is the $kx1$ vector of (weakly exogenous) regressors, μ_0 is a constant, η_t is the error-correction term, ϕ is a scalar that measures the speed of adjustment to long-term equilibrium, β is the $kx1$ vector of coefficients on the explanatory variables, $\theta = -\beta/\phi$ is a $kx1$ vector of the long-run coefficients, λ_j are scalar coefficients on lagged first-differences of dependent variables and δ_j are $kx1$ coefficient vectors on first difference of explanatory variables and their lagged values. It is assumed that the disturbance term ε_t is independently distributed with a zero mean and a constant positive variance.

3.5 Results

3.5.1 Single equation results for ρ

Following the theoretical framework discussed above, the effective lending rate ρ is introduced.[6] In table 3.2, I present the findings of the single equation results. For exposition purposes, I report the long-run component of the $ARDL(p, q)$. It is important to highlight that because of the economy-wide effects, the impulse responses in section 3.5.4 below give a better interpretation of the economy-wide co-efficients.

The estimations show a strong long-run cointegrating relationship between the effective lending rate (as a dependent variable) and the repo rate and capital adequacy ratio. In itself, this is the most significant finding: an increase in the capital adequacy ratio leads to a rise in the effective lending rate. This immediately suggests that capital adequacy ratios may influence the lending channel of monetary policy.

A related finding, presented in specification 3 and 4, is that there is evidence of long-run homogeneity between the policy rate and the lending rate. Econometrically, the Wald test does not reject the hypothesis of a unit coefficient on the long-run structural equation parameter. This is important both theoretically and for model stability. Theoretically, short-run deviations between the policy rate and the bank lending rate can be expected, but in the long run they should move together.

Nevertheless, the capital adequacy ratio is a statistically significant influence in the long-run component of the equation. A statistically significant and positive finding indicates that higher capital adequacy levels lead to higher bank lending rates, which in turn have implications for the broader economy. Estimated equation number 3.7 shows that the calculated long-run coefficient on the capital adequacy ratio is 0.44, in line with the theoretical prediction and graphical relationship shown in Figure 3.2.

I then test for various measures of demand, to understand to what extent this

[6] For a discussion on how the monetary transmission mechanism is dealt with in a large macroeconomic model, see Bernanke and Blinder (1992); Smal et al. (2007); De Jager et al. (2015)

Table 3.2: Effective lending rate equation

	Dependent variable: Δ Effective lending rate				
Long-run cointegrating relationship	(1) Output as demand proxy	(2) House prices as demand proxy	(3) (1) with restricted co-efficients	(4) (2) with restricted co-efficients	(5) (2) using Monthly data
Repo rate$_{t-I}$	0.986***	0.985***	1.000***	1.000***	1.000***
	(0.09)	(0.09)			
Capital adequacy ratio$_{t-I}$	0.416**	0.401***	0.438***	0.423***	0.486***
	(0.13)	(0.13)	(0.12)	(0.23)	(0.16)
House price index$_t$		0.0025***		0.003**	0.0003**
		(0.00)		(0.00)	(0.00)
Log (Real Output)$_t$	0.001*	-	0.001**	-	-
	(0.00)		(0.00)		
Constant	-4.415*	-3.059***	-4.872**	-3.416**	0.041*
	(2.36)	(1.93)	(1.54)	(1.45)	(0.02)
Error-correction term: Effective lending rate$_{t-I}$	-0.788***	-0.800***	-0.779***	-0.791***	-0.757***
	(0.10)	(0.09)	(0.09)	(0.09)	(0.09)
Observations	36	36	36	36	84
Adjusted R^2	0.84	0.84	0.84	0.84	0.47
Durbin-Watson	2.28	2.29	2.28	2.29	2.34
Johansen test for cointegrating long-run relationship	0.0012**	0.00***	0.0934*	0.0311**	0.0145**
Hadri test for cointegrating long-run relationship	0.00***	0.00***	0.00***	0.00***	0.00***
Wald test for long-run homogeneity	0.798	0.776	n/a	n/a	n/a
Sample (adjusted):	1999Q1 2007Q4	1999Q1 2007Q4	1999Q1 2007Q4	1999Q1 2007Q4	1999M1 2007M12

Note: *p<0.1; **p<0.05; ***p<0.01

may influence the bank lending rate. Two are reported in Table 3.2, viz. output and house prices. The latter is most commonly used in the econometric literature. However, the model does not converge when endogenous demand variables are used. For this reason, a variable exogenous to the model is used. This is a composite house-price measure, which has a 99 per cent correlation with real GDP. It is thus a useful instrument.

The available data means only nine years of quarterly data are available, and seven years of monthly data. This may appear to be a relatively short time series. It is, however, consistent with time series length used in various other international studies. However, to test co-efficient stability, the single equation is estimated using monthly data. This provides 84 observations, a substantial improvement over the quarterly data. The results, presented in Table 3.2 as specification 5, suggest that the coefficients are robust.

3.5.2 The introduction of ρ into the broader model

Based on model stability and performance, specification (4) reported in Table 3.2 is chosen for inclusion in the model. In addition, ρ is introduced into the model in two further places – the estimation of household credit extension and real consumption expenditure. These were previously a function of i, and were re-estimated to be instead a function of ρ. Both of these equations feed into the overall income and demand specification, i.e. as part of a group of equations that form part of the more detailed specification of the reduced form model presented above. Theoretically, the intuition is that both these variables are influenced by the bank lending rate. The long bond rate remains a function of the repo rate. This is an important distinction that drives some of the results presented below: the idea is that financial-market interest rates fluctuate according to the overnight policy rate, and real economy variables are a function of lending rates. Of course, the imposition of long-run homogeneity means that in the long run this distinction is irrelevant.

It is then possible to specify a new block that includes equation 3.9 with the unrestricted parameters.

Consumption and credit extension

For the equilibrium level of credit extension, one can derive a function from the equilibrium loan demand and loan supply functions provided in equation 3.7 and equation 3.8 above, substitute in for ρ and specify this as:

$$\Delta L_h = \varepsilon + \beta_1 y_t + \beta_7 \rho^* \tag{3.12}$$

such that credit extension to households (the change in the equilibrium loan stock, ΔL_h) is a function of a measure of demand, y and the equilibrium lending rate, ρ^*.

In table 3.3, I present the results of the estimated function for private household credit extension. It is notable that there is a positive cointegrating relationship between household credit extension and house prices, supporting the findings in some of the literature discussed above that rising asset prices stimulate additional credit. As expected, the long-run coefficient on the effective lending rate is negative (-0.009), with a relatively long lag (six quarters), in line with the empirical findings that monetary policy changes have long lags through the economy (see, for example, Botha et al. (2017)). I test for a short-run demand effect but this is not shown to be significant.

The consumption function in the model can be extended to include the bank lending rate:

$$y_c = \varepsilon + \beta_4 y_d + \beta_5 \rho \tag{3.13}$$

which is a simplified function that household consumption y_c is a function of household disposable income y_d and the effective lending rate ρ. The estimated results are reported in Table 3.4. I present three versions of the estimation. In specification (1), the relationship between household consumption and disposable income is unrestricted. The estimated long-run relationship is 1.09 (calculated as 0.289/0.265). In specifications (2) and (3), I impose long-run homogeneity, that is that there is a homogenous relationship between disposable income and household consumption. The relevant Wald test for homogeneity, reported in the lower panel of Table 3.4 is does not reject the null. The estimated parameters are as expected.

Table 3.3: Household credit equation

	Dependent variable:		
	Δ Log Household Credit (real)		
	(1)	(2)	(3)
ECM Log Household Credit (real)$_{t-1}$	−0.101***	−0.120***	−0.099***
	(0.016)	(0.011)	(0.019)
Calculated long-run coefficients			
Log House Price $_{t-1}$	0.126***	0.126***	0.131***
	(0.002)	(0.002)	(0.002)
Effective lending rate $_{t-6}$	−0.009**	−0.008**	−0.010
	(0.0003)	(0.0003)	(0.0004)
Constant	−0.822***	−0.975***	−0.853***
	(0.146)	(0.110)	(0.166)
Short-run coefficients			
Δ Log House prices (real)	0.112		0.123
	(0.071)		(0.081)
Dummy 2002Q4	−0.018***	−0.019***	
	(0.005)	(0.005)	
Observations	56	56	56
R^2	0.802	0.792	0.739
Adjusted R^2	0.782	0.776	0.718
Residual Std. Error	0.005 (df = 50)	0.005 (df = 51)	0.005 (df = 51)
F Statistic	40.501*** (df = 5; 50)	48.595*** (df = 4; 51)	36.075*** (df = 4; 51)
Wald test for			
long-run homogeneity	n/a	p = 0.093	p = 0.104
Sample (adjusted):	1994Q3 2008Q2	1994Q3 2008Q2	1994Q3 2008Q2
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 3.4: Household consumption equation

	Dependent variable:		
	Δ Log Household Consumption		
	(1)	(2)	(3)
ECM (Log HH Cons.$_{t-1}$)	0.265**		
	(0.109)		
Log Disp. Income $_{t-1}$	−0.289**	1.000	1.000
	(0.116)		
Calculated long-run coefficients			
Effective lending rate (real)$_{t-2}$	−0.015	−0.069*	−0.077*
	(0.010)	(0.009)	(0.009)
Inflation$_{t-2}$	−0.001**	−0.002***	−0.002***
	(0.0001)	(0.0001)	(0.0001)
Constant	0.146***	0.007***	0.007***
	(0.053)	(0.001)	(0.001)
Short-run			
Δ Disp. Income	0.261***	0.226***	0.247***
	(0.070)	(0.052)	(0.057)
Dum 2006 q1	0.006***	0.006***	
	(0.002)	(0.002)	
Dum 2002 q2	−0.003	−0.004*	
	(0.002)	(0.002)	
Observations	58	58	58
R^2	0.512	0.544	0.418
Adjusted R^2	0.444	0.491	0.374
Residual Std. Error	0.002 (df = 50)	0.002 (df = 51)	0.002 (df = 53)
F Statistic	7.491*** (df = 7; 50)	10.155*** (df = 6; 51)	9.518*** (df = 4; 53)
Note:			*p<0.1; **p<0.05; ***p<0.01

3.5.3 Weak exogeneity

The inherent pro-cyclical (and hence endogenous) nature of bank capital requirements had been identified as early as 2001 as a concern (Borio et al., 2001). During benign economic conditions, risk-based bank capital requirements encourage additional lending, further exacerbating potential credit-induced asset bubbles. This is because asset price increases supposedly reduce the potential loss when the loan goes bad. During economic downturns, bank capital requirements become increasingly onerous, discouraging lending, and exacerbating already-weak economic conditions, creating a 'credit crunch' (Bikker and Hu, 2002; Covas and Fujita, 2010), which may indeed amplify business cycles (Aliaga-Díaz and Olivero, 2012).

The approach taken in this study is to use a period where the banking supervisor exogenously increased capital adequacy levels. This differs from other studies where bank capital levels are used where there is no evidence that these are exogenously determined.

Nevertheless, the study does use observed capital adequacy levels, which may under certain circumstances be endogenous. Endogeneity may arise if non performing loans are correlated with other variables in the model.

The weak exogeneity can be tested in a number of ways. By observation, the ratio of non performing loans remains stable, indicating that the variation in observed capital adequacy can be ascribed to regulatory action rather than to non-performing loans. Indeed, theoretically, the improving economic conditions should lead to capital adequacy levels falling rather than rising.

More formally, this can also be tested econometrically. In Table 3.5, I present the results of the weak exogeneity test following Johansen (1992, 1995). In the Johansen (1995) framework, the test is whether the variable of interest's speed of adjustment vector, $\alpha_{i,j}$ is equal to zero in the cointegration system. The first two rows of Table 3.5 present a summary of the cointegration test under a number of different approaches (no intercept / no trend, etc.) From this, there appears to be one cointegrating relationship for intercept / no trend and linear data trend with intercept / no trend. Two cointegrating relationships are present for linear intercept / trend and for a quadratic intercept and tred. The null hypothesis of

$\alpha_{i,j} = 0$ is not rejected in the presence of one co-integrating vector, but rejected in the presence of two cointegrating vectors.

Based on the theoretical case for weak exogeneity, and the test statistics, I proceed on the basis of one cointegrating relationship and weak exogeneity.

Table 3.5: Co-integration and Weak exogeneity test

Data Trend:	None	None	Linear	Linear	Quadratic
Test Type	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
Trace	0	1	1	2	3
Max-Eig	0	1	1	2	3
Restriction $\alpha_{2,2} = 0^{\dagger}$					
χ^2		0.377445	0.437597	9.62206	9.701057
Probability		0.538974	0.508285	0.008139	0.007824

† $\alpha_{2,2}$ corresponds to the adjustment coefficent for the capital adequacy ratio. The null is that the capital adequacy ratio is weakly exogenous. The test is the LR test for binding restrictions (rank = 1) – see Johansen (1995).

3.5.4 Impulse responses

To measure the economy-wide effects, the effects of an increase in capital adequacy ratio are modelled and compared to a change in the repo rate.

Ex ante, one can expect a widening of the spread between rho and repo, with consequent slowdown in lending (through the credit extension link) and slowdown in the economy (through both credit extension and consumption expenditure). Building on some of the insights in Cecchetti-Kohler, four separate scenarios are run, summarised in Figure 3.3.

The first scenario considers a *transitory (four-quarter)* increase in the capital adequacy ratio. Given the interaction between macroprudential and monetary policy tools, two scenarios are considered. In *Scenario 1a*, the repo rate is kept exogenous, while in *Scenario 1b*, the repo rate is endogenous. The endogenous

response function of the repo rate is based on a standard Taylor-rule specification, calibrated on previous monetary policy responses to inflation and the output gap. The intuition is that an increase in the countercyclical capital buffer causes growth and inflation to decline, which may lead the monetary policy authority to reduce rates. (See the discussion below on the policy implications of how the two tools interact).

In short, the use of a countercyclical capital buffer as a tool should not be seen in isolation of other central bank levers.

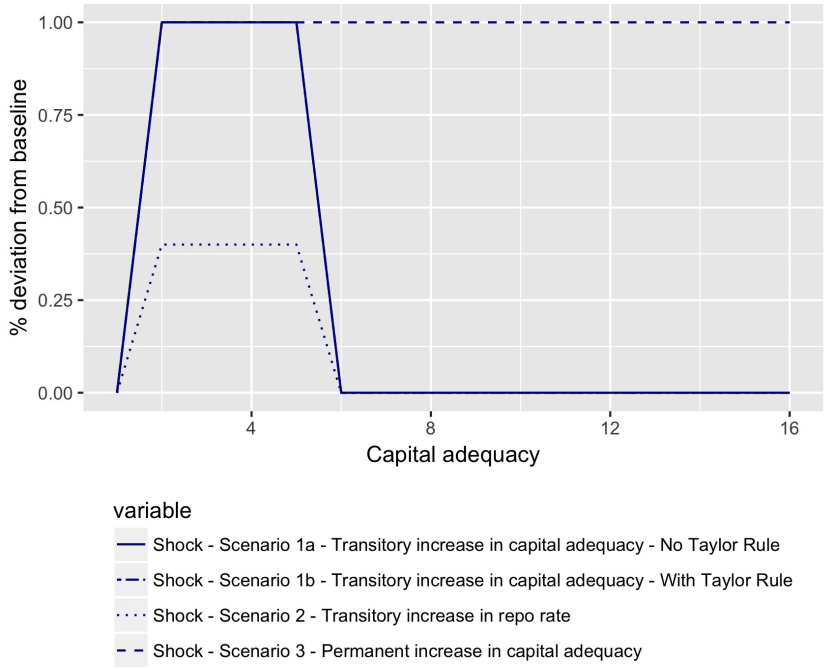


Figure 3.3: Summary of scenarios

In the first part of the analysis, Four scenarios are considered to test the response of the model. Note: the shock for Scenario 1a and 1b is identical, but the model response differs.

For the purposes of comparison, *Scenario 2* models the effect of a 40 bps increase in the repo rate. The choice of size of shock reflects the initial finding that a capital adequacy ratio shock increases the bank lending rate by 0.4 percentage points. The results of this policy tool versus the countercyclical capital ratio can

thus be directly compared. This also underlines the advantages of using a standard policy model, with a well-specified monetary policy transmission mechanism.

Scenario 3 considers the effect of a *permanent* increase in the capital adequacy ratio, with the repo rate responding through a Taylor rule.

Effect on the effective lending rate

The set-up of the model is that the increase in capital adequacy feeds through to changes in the bank lending rate, ρ. The results, presented in Figure 3.4, are as expected, with an overall increase in the bank lending rate of approximately 0.4 percentage points. As noted, with an endogenous repo rate response the repo rate declines. This feeds through to a slightly lower overall bank lending rate.

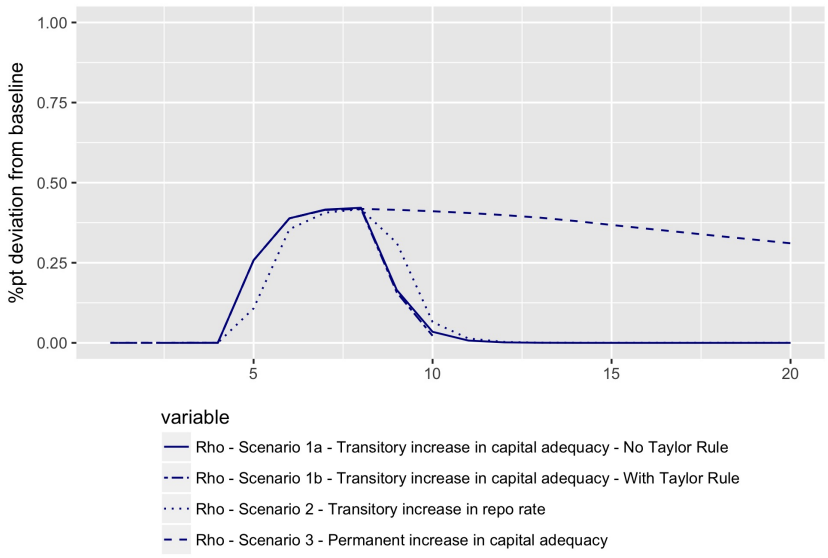


Figure 3.4: Impact on effective lending rate

The effect on the rest of the model is broadly as expected, but of note is the very small effect that the shock has on macroeconomic variables: growth declines by 0.07 percentage points, while consumer price inflation excluding mortgage costs[7]

[7]At that time, this was still the official measure, and is thus included in the model as such.

drops by between 0.02 and 0.03 percentage points.[8] Although the detailed results are not reported here, it is important to note that the impact on consumer price inflation is substantially less than that of a repo shock. This suggests that the countercyclical capital buffer cannot 'replace' the interest rate as the primary tool of monetary policy.

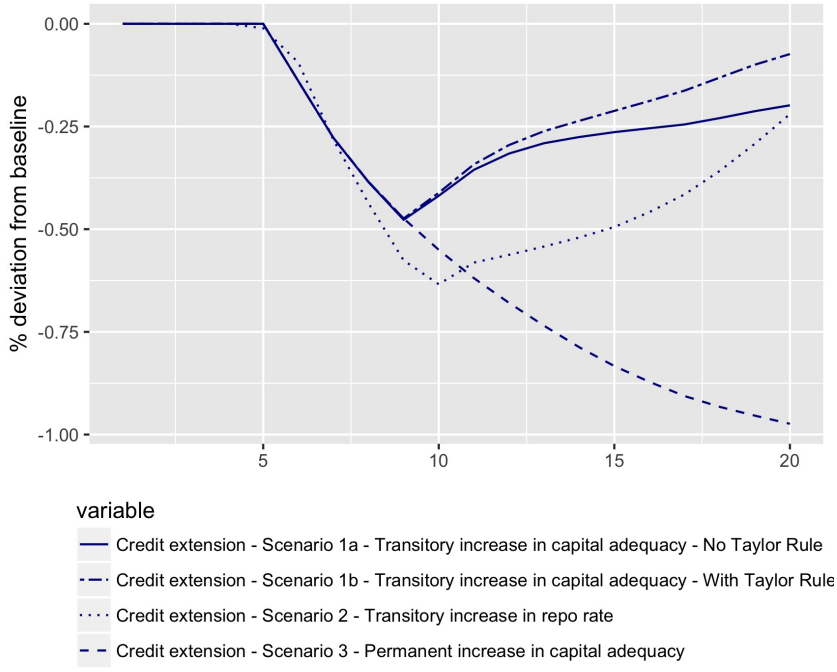


Figure 3.5: Impulse response: Credit extension

The main driver of the economic effects is through the change in credit extension, presented in Figure 3.5). In Scenario 1a and 1b, credit extension is temporarily lower by approximately 0.5 per cent relative to the baseline forecast. This is a marginally smaller decline than the equivalent repo shock. However, the repo shock is more persistent, in part because (as noted below), the repo shock has additional implications on the exchange rate and on long-term interest rates. The exchange rate appreciates and long-term interest rates rise, which has a further

[8]The BIS results were a decline of about 0.03 percentage points in the average growth rate per 1 percentage point rise in capital.

dampening effect on credit. Because the exchange rate does not adjust due to capital adequacy changes, this second-round effect does not occur.

The impact on the exchange rate and long-term interest rates

The response of the real exchange rate, bond yields, output and prices is presented in Figure 3.6.

The result for the real effective exchange rate demonstrates the particular advantage of a macroprudential tool, such as the capital adequacy ratio, over that of the policy rate.

There is a notably different exchange-rate response for a capital-adequacy shock and an interest-rate shock. This arises largely because the exchange rate is a function of interest rates: the model assumes uncovered interest-rate parity holds, and moreover, the policy rate affects long-term interest rates.

The impact on inflation and growth

The limits of the countercyclical capital adequacy ratio, however, are borne out by the effects on inflation and growth. Changes to the capital adequacy ratio have very small effects on both. This is because, in the model, the capital adequacy ratio does not lead to a significant change in either the exchange rate or government bond yields. In the model, movements in the exchange rate impact on inflation through pass-through effects. Changes to bond yields impact on growth through changes to investment (an increase in the bond yield leads to a decline).

3.5.5 Counterfactual scenario

The section above presented impulse responses to a set of innovations. In this section, I present the results in terms of a 'no action' counterfactual scenario. I rerun the model and test what the outcome would have been if the banking supervisor had *not* increased capital adequacy requirements (i.e. kept the capital adequacy ratio constant).

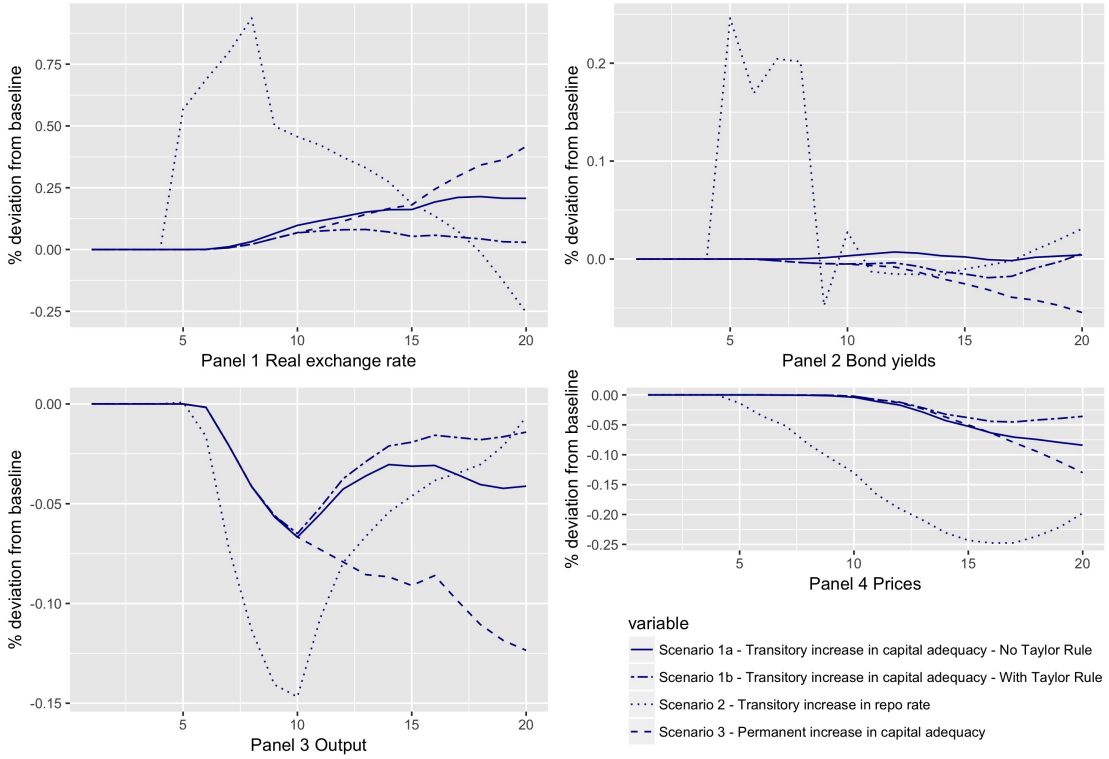


Figure 3.6: Impulse responses: Selected variables

The two policy tools have notably different effects on the real exchange rate (Panel 1), bond yields (Panel 2), output (Panel 3) and prices (Panel 4).

Counterfactual: All variables

The model computes the results for all variables that are included – i.e. a full counterfactual scenario. For brevity, here I only report the impact on six variables. As expected, the effective lending rate is lower (approximately 2 percentage points lower) in the counterfactual scenario, which leads to increased credit extension (approximately 4 percent higher). The effect on overall output is mild, with output only expected to rise by 0.3 percent. Other variables are relatively unaffected, except for a mild appreciation of the real effective exchange rate.

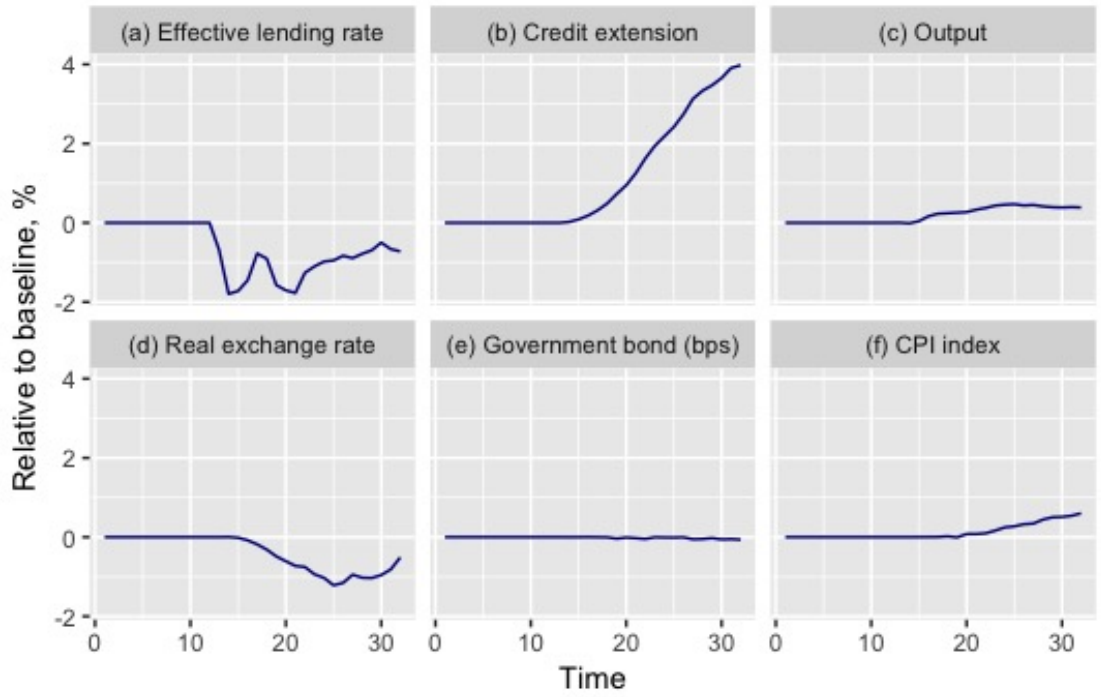


Figure 3.7: Model counterfactual

Six major macroeconomic variables are predicted based on a counterfactual of no change in the capital adequacy ratio over the period.

Counterfactual: The credit cycle

The results from the credit extension counterfactual can then be used to generate a counterfactual credit cycle. To generate this cycle, a band-pass filter is applied to the data series. A band-pass filter isolates the component of a time series that lies within a particularly band of frequencies (Christiano and Fitzgerald, 2003). The ideal band-pass filter would use a time series of an infinite length, but naturally in practice such a series does not exist, and typically some sort of approximation is required, and, for short and long series, backcasting and forecasting are options. A similar approach is used on South African data in Farrell and Kemp (2017).

Comin and Gertler (2006) argue that medium term cycles are more useful measures of fluctuations as more standard detrending methods (e.g. the well-known Hodrick-Prescott filter) may miss medium term structural variations. For

this reason Drehmann et al. (2012) chose to follow the methodology for calculating financial cycles.

The approach laid out in Comin and Gertler (2006, 526) is followed. Prior to running the band-pass filter, the variables (credit, credit to GDP, house prices) are converted into growth rates by taking log differences. Following Drehmann et al. (2012), the annual growth rate is used for quarterly data. This is to ensure that when longer annual data sets are used, the data set is more comparable.

In this analysis, I report the credit cycle and not the full cycle. Farrell and Kemp (2017) demonstrate that the credit cycle drives the majority of the movement in the overall cycle, and the other variables used in the cycle are not specified as endogenous in the model.

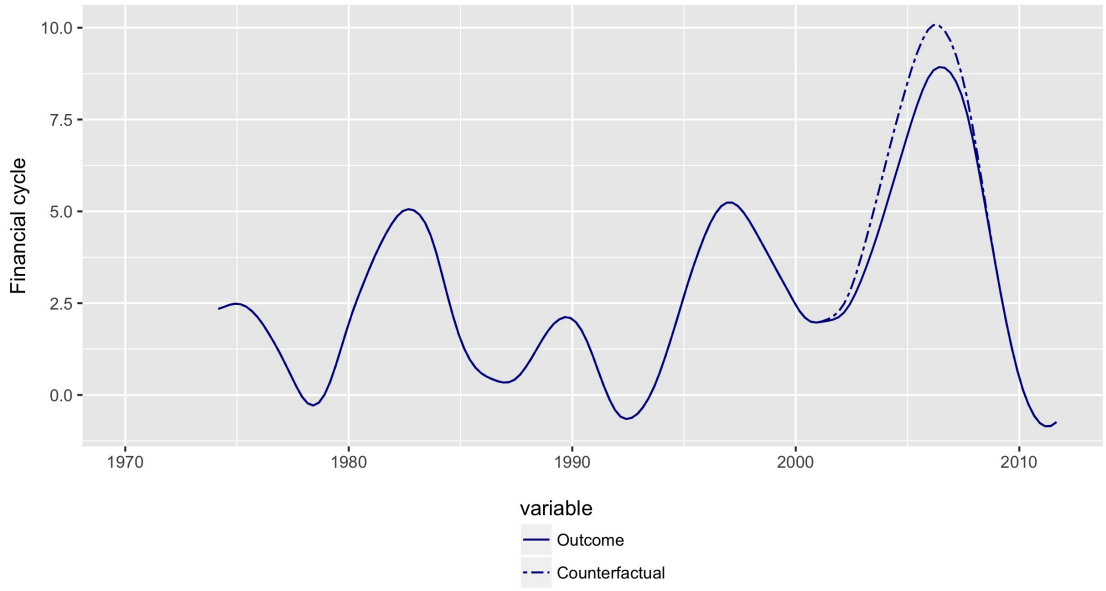


Figure 3.8: Credit cycle counterfactual

This compares a counterfactual of no capital adequacy increase with the actual outcome. In the counterfactual of no increase in capital adequacy, there is a notable acceleration of the credit cycle.

In Figure 3.8, the credit cycle is presented together with a counterfactual of no regulatory action. This analysis shows that the regulatory action dampened the

peak of financial cycle at an important time (during the course of 2006 to 2007) as the international economy was overheating and nearing the events of 2007 that ultimately led to the 2008 global financial crisis.

3.6 Lessons for the policy framework

Beau et al. (2012) and Sinclair and Farrell (2017) provide a simple, but effective, mechanism to understand the interaction between the monetary policy tool and a macroprudential policy tool such as the countercyclical capital buffer (see Table 3.6). In this approach, the authorities determine both financial stability conditions and monetary conditions. Financial stability is considered as the degree of imbalance in financial markets – typically using a standard metric such as the credit-to-GDP ratio, complemented by analysis of financial market conditions (for a discussion on the difficulties with various measures, see Havemann (2013) or Farrell (2016)). Monetary conditions are considered using the standard inflation-rate targeting framework. It is the interaction between the two tools that creates the difficulties, however. When there is both 'financial exuberance' and 'high inflation', the economy is clearly overheating, and a mix of monetary and macroprudential policy tools can be deployed. Policy decisions are not always that clear cut – the approach highlights that tools can, under certain conditions, be in conflict.

In the South African case (as with many emerging markets), the zero lower bound does not bind. This creates more scope for coordinated policy setting, allowing for the deployment of a mix of interest rate and macroprudential tools.

This framework can also be extended to consider the sequencing of policy decisions, and the degree of coordination (Cecchetti and Kohler, 2012; Du Plessis et al., 2011). Policies can be set independently, in a coordinated way, or as Stackelberg-type game.[9] This appears to describe the 2002 – 2007 experience outlined above best. The banking supervisor responded to interest-rate decisions. The 'initial play' of interest rate cuts stimulated credit. Against the backdrop of benign global conditions, a domestic 'credit bubble' developed. The regulator observed this 'play' and 'outcome' and responded by raising system-wide capital

[9]Stackelberg is where one policy maker sets the policy without considering the impact on the other. Then the second policy maker sets his or her policy, taking the first decision as given.

adequacy levels.

Table 3.6: Interaction between macroprudential and monetary policy

	Expected inflation		
	Over target	Near target	Under target
Financial exuberance	Complement	Independent	Conflict
No imbalance	Independent	Independent	Independent
Financial deflation	Conflict	Independent	Complement

Source: Beau et al. (2012)

One further extension to consider is a Cournot Nash equilibrium, where the two decision makers are aware of each other's best play, have nearly equally matched power, and play accordingly. The outcome is a standard Nash equilibrium.

A jointly-determined equilibrium is particularly relevant where the central bank has both a financial stability and inflation-targeting mandate, and has two committees with overlapping membership jointly determining a strategy.

One approach to a such a coordinated outcome is to adjust the monetary authorities reaction function to include financial stability. A particularly workable approach is a modified Taylor rule, where financial stability is explicitly included in the central bank policy reaction function. Notable examples of work in this tradition include Taylor (2009), which lays out a potential framework, Curdia and Woodford (2010) which incorporates an endogenous reaction function into a new Keynesian model and Angelini et al. (2014) which includes it in a DSGE framework.

As a small-open economy, for South Africa, a practical example of implementing these tools is in the context of an external shock, where a combination of monetary and macroprudential policy tools can provide for a more nuanced response. An example of such a shock is a capital inflow shock, which presents particular difficulties for policy makers in small-open economies. Such shocks are, in certain circumstances, expansionary, creating the well-known 'policy dilemma', summarised by Blanchard et al. (2016):

> For a given policy rate, bond inflows lead to an appreciation and are contractionary. For a given policy rate, non-bond inflows also lead to an appreciation, but they also decrease the cost of borrowing, and their net effect may be expansionary.

Raising interest rates to deal with inflows may cause additional flows (non-bonds and bonds) and have the unintended consequence of reinforcing or even exacerbating the expansionary shock. Moreover, the appreciation of the exchange rate has the perverse outcome of dampening inflation, creating precisely the scenario of 'financial exuberance' / 'under target' inflation.

The results presented above suggest that the central bank could consider dampening the expansionary effect of inflows by raising the capital adequacy ratio. This has the desired effect of reducing credit growth and dampening demand, without the consequence of the exchange rate channel.

Nevertheless, macroprudential policy is no 'silver bullet' to deal with an open capital account. Caruana et al. (2014), for example, summarise the literature that concludes that the adjustment to capital inflows should first take place through the exchange rate, and potentially fiscal policy and interest rate policy, with macroprudential policy playing a complementary role.

3.7 Conclusion

This chapter posited that one of the reasons for South Africa successfully weathering the global financial crisis was proactive countercyclical regulatory policy. The chapter set out to empirically determine the effect on the economy of using counter-cyclical capital adequacy buffers, using South Africa's experience. The results suggest that such buffers can be useful to lean against credit cycles, but that capital adequacy increases may need to be quite large to have any meaningful impact on credit extension or on economic activity (towards the upper end of the 0 to 2.5 per cent of risk-weighted assets proposed in the guidance to authorities).

Indeed, using the pre-crisis experience of South Africa, it is estimated that a 1 percentage point increase in the capital adequacy ratio has an economy-wide effect of approximately the same as an increase in the policy rate of 0.3 to 0.4 percentage

points. Put another way, to achieve the same result as an increase in the policy rate of 1 percentage point, capital adequacy ratios would need to rise by between 2.5 and 3 percentage points.

The two tools have subtly different macroeconomic effects. Increasing capital adequacy ratios impacts on bank lending rates, while other interest rates (e.g. the long government bond rate) are largely unchanged. This means far less of an effect on the real exchange rate; indeed, with the growth decline, the real exchange rate may actually depreciate. This is particularly useful for countries that are experiencing credit booms fuelled by capital flows, where an interest increase could have *a priori* ambiguous effects on credit extension. Also, consistent with the Bank of International Settlement Macroeconomic Assessment Group results, capital adequacy ratio increases have very small growth impacts.

The results suggest that there is merit in introducing macroprudential policy tools to *complement* monetary policy tools, as part of a broader toolkit of policy measures for managing macroeconomic fluctuations.

This chapter considered the use of proactive tools to dampen financial cycles. But what if a failure occurs? The next chapter considers the use of new bank resolution tools to manage the financial spillovers from bank failures.

Chapter 4

African Bank and the money-market run of 2014

African Bank was placed into curatorship in August 2014. The authorities used new post-crisis bank resolution tools to impose losses on creditors. The bank was mainly funded by money-market and other mutual funds. Over fifteen money-market funds broke the buck, the most significant such event since the collapse of Reserve Primary Fund. I show that the bail-in led to some financial spillovers, but these were limited due to the central bank undertaking complementary interventions such as imposing gating restrictions on funds and providing liquidity assistance to banks and non-banks.

4.1 Introduction

The costs of the global financial crisis highlighted the need for 'burden-sharing arrangements', which aim to share the costs of bank failures between creditors and government. These reforms include 'creditor bail-in' and 'contingent convertible bonds'. The former is a mechanism to write-down the claims of creditors during the bank resolution process. The latter creates powers to convert debt to equity, contingent on a specified event. The resolution of African Bank,[1] a small monoline

[1]Throughout the text, African Bank refers to African Bank Ltd, registered as a bank. References to the broader group are African Bank Investments Ltd.

South African lender, presents a unique opportunity to study the spillover effects of using these new tools. The bank was almost exclusively funded by wholesale (i.e. not retail) funding, with a notable portion (6.9 per cent) of its funding from mutual funds, particularly money-market funds. It is one of the first emerging market bank resolutions that included the bail-in of creditors, and, following the bail-in, there were substantial money-market fund redemptions, with potential contagion through financial interlinkages.[2] All affected money-market funds 'broke the buck', the most significant such episode since the breaking of the buck by Reserve Primary Fund on September 16, 2008.

The paper exploits a unique data set, containing both daily and quarterly frequencies, including data down to mutual fund holdings at financial-instrument level. Controlling for other factors which may influence redemption patterns, I show that redemptions occurred disproportionately in money-market funds with African Bank exposure. There is evidence of financial spillovers to the rest of the financial system, albeit limited. A larger failure, a larger haircut, or a poorly-designed resolution could potentially have triggered broader spillover with possible systemic consequences, including contagion to other banks.

The impact on constant net asset value money-market funds is compared to that of variable net asset value income funds.[3] Outflows from the latter were smaller, adding to evidence that constant net asset value funds are a source of risk themselves.

The implication is that creditor bail-in is a potentially useful resolution tool, but needs to be used carefully. The systemic consequences can be reduced through a transparent and clear ex ante bail-in framework, supported by enhanced regulation of mutual funds, particularly money-market funds, to reduce their fragility. Regulatory reforms can reduce the systemic risk posed by money-market funds, e.g. phasing out constant net asset value and introducing powers to impose discretionary liquidity restrictions and suspend convertibility.

In section 2, I highlight how this paper contributes to the related literature, particularly the literature on bail-in and money-market funds. Section 3 provides

[2]Contagion is defined following Iyer and Peydro (2011) that '[t]here is contagion if the failure of a bank causes a significant negative externality to other banks'.

[3]Constant net asset value (C-NAV) mutual funds maintain a unit net asset value. In contrast, variable net asset funds (V-NAV) mutual funds have a fluctuating market price.

the institutional setting, including the relevant global regulatory reforms. Section 4 sets out the event, highlighting how the bail-in of African Bank creditors was achieved. The following two sections outline the data and empirical strategy. The final section concludes.

4.2 Related literature

The paper contributes to a small but growing literature on the practicalities and potential unintended consequences of bail-in and contingent convertible bonds, particularly that using these tools may magnify rather than dampen systemic risk during failures (see, for example, Goodhart (2010), Geithner (2014), Avgouleas and Goodhart (2015) and Hüser et al. (2017)). The paper presents a case study[4] and so also links to the literature on individual bank runs or groups of runs in the tradition of Iyer et al. (2012), Shin (2009) and Iyer et al. (2016).

The paper also provides insights on how money-market funds behave when faced with an idiosyncratic shock. This literature notes that money-market funds with a constant net asset value (C-NAV) provide an implicit capital guarantee, making them analagous to banks without deposit insurance. These funds may thus be more susceptible to runs and specific types of runs.[5]

Kacperczyk and Schnabl (2013) examine money-market funds in the run-up to the global financial crisis noting evidence that fund inflows were positively correlated with fund risk. More risky funds also suffered larger runs following shocks. Moreover, money-market funds do have liquidity mismatches, albeit limited. A sudden increase in demand for redemptions has a similar impact on a money-market fund as a sudden increase in demand for uninsured bank deposits, with Wermers (2012), and a related paper Schmidt et al. (2016) noting that illiquidity may create strategic complementarities. In the United States, for

[4]Prior to this case, the most notable example was the 2013 bail-in of depositors in Cyprus. From 2016, bail-in became mandatory in EU member states as part of the Bank Recovery and Resolution Directive. For a review of European case studies see The World Bank (2016).

[5]This literature in turn builds on the seminal papers on bank runs, in particular Diamond and Dybvig (1983), and the information effects in Postlewaite and Vives (1987), Bryant (1980), Chari and Jagannathan (1988) and Jacklin and Bhattacharya (1988). Signals are considered in Carlsson and van Damme (1993), Morris and Shin (2000), Morris and Shin (2003) and Goldstein and Pauzner (2005).

example, Chen et al. (2010) find that money-market mutual funds with more illiquid assets experience a larger outflow in response to bad news. The relative illiquidity of corporate bonds may create either first-mover advantages or strategic complementarities. A related effect is that of the 'flight from maturity' (Gorton et al., 2014).

Schmidt et al. (2016) argue that, after a shock, redemptions by 'sophisticated' investors should be larger. Money-market funds are also often underwritten by 'sponsors', which Acharya et al. (2013) find could precipitate contagion by imposing losses on the sponsor, typically a bank.

Large redemptions from money-market funds may create financial spillovers in multiple other ways, including that the bail-in of one bank may cause concern about common exposures, and mutual fund managers may decide to pre-emptively liquidate holdings of banks with similar assets (Allen and Gale, 2000; Ahnert and Georg, 2018). Asset managers may also choose to liquidate assets to meet large redemption requests, causing fire sales (Morris et al., n.d.), which may create a 'cascade of defaults' (Battiston et al., 2012) and create a fall in transaction values. Money-market funds may have exposures to multiple banks, and banks may in turn have large exposures to money-market funds. This series of overlapping claims creates an opaque network, which may make a financial system intermediated by money-market funds more fragile (Cipriani et al., 2014; Hüser et al., 2017).

This paper also links to the literature on signals – bail-in arguably provides a signal to players about the financial position of similar banks. Morris and Shin (1999) posit that in a global games setting with firms facing liquidation, intervention by public authorities may solve a co-ordination problem, reducing the likelihood of a messy, inefficient liquidation. Baeriswyl and Cornand (2010) note that authorities may well use policy signals to influence behavior. That said, importantly for this analysis, Angeletos et al. (2006) argue that policy interventions may create multiple equilibria, with the decision maker caught in a trap where his or her decision dictates both the coordination outcome and thus, by deduction, the policy intervention. The signals also cause participants to update information about other banks (Allen and Gale, 2000; Acharya, 2009; Allen et al., 2011; Cipriani et al., 2014; Ahnert and Georg, 2018).

There is also a strand of money-market fund literature considering the effect

of various regulatory reform proposals. Here I examine the performance of variable net asset value funds against constant net asset value funds and the use of discretionary liquidity facilities, illustrating some of the findings in the theoretical literature (see, for example, Parlatore (2016)) that argues that adopting a variable net asset value reduces the risk to investing in money-market funds (as they are inherently less fragile), but also reduces the potential return, with mixed effects on liquidity.

4.3 The institutional setting

4.3.1 The regulatory reforms

The regulatory reforms that introduce 'bail-in' and 'contingent convertible' (or 'co-co') debt are intended to provide an alternative to 'bail-out'. When a bank faces a solvency shortfall, bail-in gives powers to the regulator to recapitalize the bank by writing down the claims of creditors, while in the case of contingent convertible bonds, these claims can be converted to equity. This is instead of taxpayers providing a bail-out.[6] By shifting losses to creditors, and away from taxpayers, the intention is to break the cycle of deteriorating sovereign and banking system health.

Bail-in and contingent convertible bonds also have putative ex ante benefits – they may increase artificially-low funding costs for systemically important banks and thus reduce the ex ante incentives these banks enjoy. These arise because bondholders anticipate that 'too-big-to-fail' banks have a lower credit risk as there is an implicit state guarantee (Dewatripont and Freixas, 2012; Hett and Schmidt, 2014).[7]

Interventions are only appropriate in idiosyncratic situations (Goodhart, 2010) as the intervention itself could 'warn' agents of further action. The point where the

[6] For a discussion of the regulatory reforms see Financial Stability Board (2014), for a review of how countries have implemented bail-in see Financial Stability Board (2016) and for details of the process see Zhou et al. (n.d.).

[7] Persaud (2014) takes a contrary view noting that, on a risk-adjusted basis, the return on securities with bail-in characteristics is misaligned, and systemically important banks still issue bail-in securities at artificially low yields.

instrument converts (the 'trigger point') could become self-fulfilling. For example, assuming that market capitalisation is the trigger point, a 'death spiral' may ensue – as market capitalisation falls towards the trigger, there may be a discontinuous sudden collapse (Perotti and Flannery, 2011).

The reforms also attempt to solve a political question about who bears the burden of a bank failure, but the political dimension of 'burden sharing' is not straightforward (see, for example Allen et al. (2017)). During 2016, for example, authorities were reluctant to bail-in bondholders of Banca Monte dei Paschi di Siena, an Italian bank. This was in part because the bondholders were large pension funds, and politically it was difficult to impose losses on a politically powerful constituency.

4.3.2 The African Bank case

Growth phase: 2008 to 2013

African Bank Investments Limited, a holding company, had three main subsidiaries – a furniture retailer (Ellerines) that it purchased in 2008, a consumer credit insurer (Stangen), and a bank. This bank, African Bank, was a monoline lender, lending almost exclusively to low-income earners on an unsecured basis. Despite its banking licence, the bank had historically not taken significant retail deposits, rather relying on wholesale funding, primarily from bondholders, including pension and mutual funds.

From 2008, the group grew rapidly, supported by cross-selling of products and services between the different parts of the group. It was evident, however, that the furniture subsidiary had been bought at an inflated valuation.[8] A series of writedowns reduced its value significantly. Before being bought, it had also sold furniture for cash or on hire-purchase. The shift to unsecured lending caused an increase in defaults.[9]

[8]The official report on the failure, Myburgh (2016), details multiple problems at the furniture subsidiary which appeared to be unknown to African Bank, including poor credit controls and poor governance.

[9]Previously, lending to Ellerines customers was on a hire-purchase collateralised basis, with the right to repossess furniture. This was changed to unsecured lending in Ellerines stores which could be used for furniture. Unsecured loans came with credit insurance provided by Stangen, but with extensive exclusions. In addition, personal unsecured loans were provided direct to

Despite these challenges, lending growth continued. By 2011, the growth in its unsecured lending book was over 50 per cent per year, in marked contrast to the industry average of 10 per cent. African Bank had exposure to low-income employees across all sectors, including mining. During 2012 a sustained mining strike, including violence in the platinum mining industry, created substantial financial distress amongst borrowers. The majority of loans written in the fourth quarter of 2012, which followed these severe problems in the mining sector, ultimately turned bad.

Bank deteriorates: Late 2013

The funding structure was short-term and mainly wholesale, increasing funding risk. African Bank had the highest concentration of liabilities to domestic 'other financial intermediaries' (67.4 per cent), i.e. mutual funds, pension funds and other non-bank intermediaries (see Table 4.1). Moreover, African Bank had a substantially high exposure to foreign-currency funding (25.4 per cent of liabilities), in marked contrast to other banks, where the average bank's exposure varied between 5 and 10 per cent.

Table 4.1: Liability holders: African Bank, 30 June 2014

Type of fund	Holding (ZARbn)	Share*
Domestic money-market funds	2.9	6.9%
Other mutual funds and pension funds	28.4	67.4%
Foreign funds	10.7	25.4%
Retail depositors	0.1	0.3%
Total	42.1	100.0%

* Share of African Bank liabilities
Source: Own calculations based on regulatory and industry data sets, ABIL data and Sewell and Woodrow (2014) (see discussion below).

In November 2013, African Bank Investments Ltd announced that its business had deteriorated substantially, with headline earnings falling 88 per cent and credit

customers through a branch network and in Ellerines stores.

impairments rising to R8.27 billion, about 20 per cent of its balance sheet. It argued a recapitalisation would place the business on a sound footing. Accordingly, the company managed to launch a rights issue for 685.3 million new ordinary shares, priced at 800 cents a share. This was a discount of 38.7 per cent to the theoretical price.

The recapitalisation did not assuage the fears of bondholders. A slow run, or 'walk' of wholesale funders began. Total liabilities declined by R8 billion, from R59 billion to R51 billion, over the course of six months. The decline in liabilities was indeed only rand liabilities, which fell from R46 billion to R36 billion during the period, with foreign currency liabilities rising by R2 billion. There was a 'flight from maturity' (Gorton et al., 2014). Short-term liabilities rose from 10 to 14 per cent of total overall liabilities over the space of a year. The yield on short-term instruments rose. Some money-market funds pre-emptively reduced exposure to the bank. However, the increased yield on, and greater issuance of, short-term debt encouraged less conservative money-market funds to increase exposure.

Credit impairments continued to rise. For the bank, non-performing loans (NPLs) rose to to 31.7 per cent of gross loans in March 2014, from 28.2 per cent as of September 2013. For the comparative period, provisions for credit losses increased to 26.3 per cent of average gross loans, from to 15.5 per cent. Moody's Investment Service reduced the group's rating to sub-investment grade on May 30, 2014. Offshore funds which had mandates linked to the ratings were forced to sell African Bank debt instruments, and yields on African Bank debt nearly doubled, rising by approximately 300 to 400 basis points.

4.4 The event: bail-in of creditors

On the evening of Wednesday, August 6, 2014, African Bank issued a profit warning. To maintain both regulatory requirements and solvency, it indicated it needed a R8 billion recapitalisation, which would also be through a rights issue as in the previous year. The impact was immediate. The share price slid from 500c to 35c per share over twenty-four hours and some of the international bond prices fell as far as 50 per cent of par. By the close of trade that week, the share price was nearly zero.

On Sunday, August 10, 2014, the weekend following the profit warning, the bank was placed under curatorship (statutory management), and the bail-in of creditors was announced. The components of the write-down announcement included the following elements: The bank would be split into a 'good bank' and a 'bad / residual bank'. Reasonably well-performing loans would be transferred to the good bank, while the remaining non-performing loans would remain behind in the residual bank, which would be gradually wound down. The claims of senior unsecured bondholders were separated out into two: A claim in the 'good bank', at 90 per cent of the face value of their instruments and a 'stub' claim in the 'residual bank' of 10 per cent of the value of their instruments. The understanding was that the claim in the residual bank was essentially worthless. This had the same effect as an enforced 'bail-in', in that bondholders had little choice but to accept potential losses in order to achieve the resolution of the bank. (However, this meant that it was not a true bail-in. Bondholders retained a residual debt claim.) Subordinated creditors initially lost their entire holdings. Subsequently, a compromise between senior, subordinated creditors and the Reserve Bank was reached, and it was agreed that subordinated creditors would be transferred to the good bank at 37.5 per cent of their holdings. (Subsequent announcements also clarified that interest would accrue, and that maturities would be extended.) To forestall a potential freeze in money-market instruments, on the morning following the resolution, the large banks offered unlimited buy-back for overnight instruments they had issued. This promise was backed up by the standing liquidity facility from the central bank.

4.4.1 Money-market funds 'break the buck'

Before the market opened on Monday, August 11 2014, the regulator instructed money-market funds with African Bank exposure to reprice this exposure and take into account the 10% haircut. The effect was a negative impact on the value of all exposed money-market funds.

Exposed money-market funds 'broke the buck', i.e. registered capital losses. But the 'breaking of the buck' was purely mechanical and an outcome of the regulatory formula and the haircut, and not due to sudden large redemptions. In terms of the relevant regulation (Board Notice 90, paragraph 7), 'a reduction in

value occurs where a loss of a sale or a default of a money-market instrument results in a loss greater than the income accrued in the portfolio in an accounting period' (Financial Services Board, 2014). The accounting period under the law is one day.

The full write-down of 10 per cent of the value of African Bank instruments was thus offset first against the daily yield of the money-market fund and, if that was not sufficient, then the capital was reduced. It was essentially treated as a 'negative yield'.[10] The bail-in imposed on funds was larger than the daily yields. Thus it was inevitable that all funds with any African Bank exposure had a capital write-down. We show below that the large redemptions did not cause the breaking of the buck. Rather, the redemptions accelerated *after* the breaking of the buck.

Moreover, to forestall an uninformed run, funds with exposure in African Bank were given the option to transfer holdings to separate retention funds, with the effect of creating a type of discretionary liquidity restriction.[11] This ostensibly made the valuation of the money-market fund transparent and immediate; reducing the likelihood of a run, and reducing 'first-mover advantage'. The reorganisation took place before the market opened. Only four money-market funds chose to use retention funds, while nine did not; and one chose sponsor support.

Release of information on exposures

Money-market funds voluntarily regularly release 'fact sheets' containing a summary of the largest holdings of the fund, typically the ten largest exposures. These are available to investors, and are also collated by third-party information services, e.g. Morningstar. A review of the fact sheets shows that African Bank did not qualify as a 'top-ten exposure' for any fund. Up to the bail-in event, it is unlikely that retail investors knew what the extent of holdings were. More sophisticated investors may have had more information, partly through ongoing interaction with

[10] A detailed breakdown of each fund's approach to the event is provided at https://www.psg.co.za/wealth/funds_impacted_by_abil, with worked calculation examples.

[11] During periods of distress, first-movers benefit from being able to access the liquid assets first, known as 'sequential service' Goldstein et al. (2016). This leaves an ever-diminishing pool of assets for investors who act later. To forestall the potential run, discretionary liquidity restrictions stop early movers from withdrawing their entire investment. For a discussion of the use of these restrictions following the global financial crisis see Aiken et al. (2015).

the fund managers. However, it is unlikely that they had detailed information.[12]

On the Monday morning following the bail-in, however, the information set available changed significantly. All funds were forced to both announce their exposure to African Bank, and announce the impact on the fund. Funds communicated this via text message or e-mail to their clients early on Monday.

4.5 Data

Two mutual fund data sets were compiled for the empirical analysis – an extensive quarterly mutual fund data set (*'Quarterly data set'*) and a more limited daily mutual fund data set (*'Daily data set'*).

The focus here is on interest-bearing mutual funds, particularly money-market funds and short-term 'income' funds. *Money-market funds*[13] are the largest interest-bearing type of fund, with assets under management of approximately R267 billion in March 2016, or 10.7 per cent of GDP. These funds must maintain a constant net asset value (NAV) of 1; and may only invest in money-market instruments with a residual maturity of less than 13 months, a weighted average duration of 90 days, and a weighted average remaining life of 120 days. *Income funds* ('short-term interest-bearing') funds do not maintain a constant NAV, and may invest in longer-dated instruments, but in other respects are most like money-market funds.[14]

4.5.1 Quarterly data

The quarterly data set contains consistent data for all money-market and income funds from March 2013 to March 2015. The data was collated from quarterly mutual fund reports published by the Association of Savings and Investment South

[12] This was confirmed through interviews with large institutional investors.

[13] Money-market funds are regulated under Board Notice 90 of the Collective Investment Schemes Control Act (2002). The regulatory framework is similar to that of the relevant Securities and Exchanges Commission requirement (rule 2a-7) requirements for money-market funds and the European Union UCITs standards.

[14] The classification scheme follows the industry association's fund classification scheme, available at http://www.asisa.org.za

Africa.[15] All registered mutual funds submit data on a prescribed template to the Association, which publishes the data on a regular and consistent basis.

The data set has 19,314 data points. There is sufficient data on 74 interest-bearing mutual funds, of which 37 are money-market funds and 37 are income funds. There are 29 fields of information per fund (individual-specific, time variant). This includes information on the aggregated portfolio allocation of each fund by type of financial instrument and by maturity. Financial instruments are categorised and aggregated into nine categories, viz. instruments issued by government, other public entities, non-financial corporations, financial corporations, cash instruments, derivatives instruments, and listed and unlisted money-market instruments.

Eight maturity buckets are reported (overnight, 0-3, 3-6, 6-12 months, and 1-3, 3-7, 7-12 and more than 12 years). The source of funds is either retail or institutional. The former is defined as natural persons, whereas the latter is non-natural persons and can include institutional investors such as pension funds and life companies, large corporations or other funds.[16] There is also information on average balances, and the number of accounts.

Table 4.2 reports summary statistics for June 2014, shortly before the curatorship announcement. The data summarises the data into constant NAV money-market funds and variable NAV income funds. It also provides details on average returns and portfolio allocation across the different types of funds. These differences are discussed in more detail below.

[15] See https://www.asisa.org.za/statistics/.

[16] Large and sophisticated corporations typically hold operational balances in overnight money-market funds.

Table 4.2: Summary statistics, quarterly data, June 2014

Interest-bearing funds	**All funds**	**MMFs**			**Income**		
	All	All	Yes[1]	No[1]	All	Yes	No
	N = 77	N = 37	N = 14	N = 23	N = 37	N = 11	N = 26
Net asset value (Mean, ZARm)	4,985	7,281	15,900	3,143	2,861	5,301	1,935
Avg balance (ZARm)	0.56	0.70	3.55	0.25	0.33	0.34	0.32
Share retail investors	44%	34%	32%	35%	54%	56%	53%
Number of accounts	7,376	9,580	3,980	12,267	5,286	10,629	3,444
Portfolio by issuer							
Non-financial corporations	4.5%	3.2%	3.9%	1.8%	6.8%	0.1%	16.1%
Financial corporations	89.9%	95.1%	95.3%	94.7%	80.6%	95.6%	59.9%
- Deposits	24.1%	35.9%	48.5%	9.7%	2.9%	2.9%	2.9%
- Debt	35.9%	31.0%	30.4%	32.2%	44.8%	45.0%	44.4%
- Unlisted money-market instruments	29.9%	28.2%	16.4%	52.8%	33.0%	47.7%	12.6%
- African Bank	1.7%	1.1%	1.6%	0.0%	2.8%	4.9%	0.0%
Government	0.6%	0.7%	0.1%	2.0%	0.4%	0.2%	0.7%
Public entity	1.6%	1.0%	0.7%	1.5%	2.9%	2.9%	2.8%
Other mutual funds	3.3%	0.0%	0.0%	0.0%	9.3%	1.2%	20.5%
	100%	100%	100%	100%	100%	100%	100%
Portfolio by maturity							
Overnight	8.9%	11.0%	11.9%	9.0%	3.1%	1.0%	6.8%
0-3 Months	34.8%	39.7%	42.6%	33.3%	21.5%	20.7%	22.9%
3-6 Months	23.6%	24.3%	18.7%	36.5%	21.7%	29.2%	8.3%
6-12 Months	23.2%	24.7%	26.8%	20.1%	19.0%	14.2%	27.7%
1-3 Years	8.2%	0.3%	0.0%	1.1%	29.8%	33.4%	23.4%
3-7 Years	0.9%	0.0%	0.0%	0.0%	3.4%	1.4%	6.9%
7-12 Years	0.2%	0.0%	0.0%	0.0%	0.8%	0.0%	2.0%
$>$ 12 Years	0.2%	0.0%	0.0%	0.0%	0.8%	0.0%	2.0%
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

[1] Yes (No) - (Not) exposed to African Bank instruments on June 2014
Source: Quarterly data set (see text)

4.5.2 Daily data set

The second data set contains *daily data* on money-market funds and income funds. It is collated from daily reports by *Profile Data*[17] and cross-checked against information from *Morningstar*,[18] two third-party providers of mutual fund information. A daily data set is available on fund size, most recent return,[19] total expense ratio, transaction cost and total investment cost.[20]

The daily set contains a subset of large funds. Summary statistics are reported in Table 4.3. There are a total of 103,000 data points, made up of 515 days of data beginning from before the event until two years after the event; and 50 funds, with four fields of fund-specific, time-variant information per fund. For money-market funds, the daily data set contains 17 funds compared to the 37 funds in the quarterly data set. At September 2014, the total money-market fund holdings in the daily set amounted to R163.5 billion, compared to the total assets of the funds in the quarterly data set of R241.5 billion. Put another way, the daily set contains 46 per cent of the funds by number and 68 per cent by value. Returns are calculated as the annualised monthly yield on the fund (distributions as a percentage of the fund).

For income funds, the daily set contains 33 funds, compared to 37 funds in the quarterly data set. The daily data has 89 per cent by number and 65 per cent by value. For income funds, returns are calculated in two ways. The first is the annual income and capital gains distributions, which are slightly misleadingly termed dividends. These are expressed as a percentage of the fund. The second is the change in the NAV. The fund-level return and TER data are matched to the quarterly data set.

The significant difference between the two data sets is that the daily set only has information on NAVs, returns and costs, whereas the quarterly set has extensive information on holdings.

[17] http://www.profile.co.za

[18] http://www.morningstar.co.za

[19] Measured as the annualised interest and dividend yield paid to investors.

[20] The total expense ratio is an industry-wide measure of the cost of administering the portfolio relative to the NAV, transaction costs related to the costs of buying or selling the fund, and total investment cost is an aggregate of the two measures.

Table 4.3: Summary statistics, daily data, 31 July 2014

Interest-bearing funds	**All funds**	**MMFs**			**Income**		
	All	All	Yes[1]	No[1]	All	Yes	No
	N = 50	N = 17	N = 9	N = 8	N = 33	N = 6	N = 27
Fund size (mean)	4,641.14	10,665.10	18,019.91	3,298.26	1,873.37	788.19	2,083.41
Annual return							
- Interest distributions (MMFs)		5.18	5.11	5.23			
- Interest and dividend distributions (Income funds)					5.89	6.17	5.67
Total expense ratio	0.83	0.45	0.48	0.43	1.01	1.10	0.99

[1] Yes (No) - (Not) exposed to African Bank instruments.
Source: Daily data set (see text)

4.5.3 Supplementary financial instrument level data

Additional data was obtained from the regulator of mutual funds and merged with the main quarterly data set. This data set is a limited subset of 35 large income and money-market funds at two dates, end of June 2014 and end of September 2014. The data capture approximately 20 per cent of the money market and income funds by value, and 45 per cent by number. The data provide the exposure of these funds to 2,422 financial instruments, issued by 206 issuers at the end of June 2014 and the end of September 2014. Each instrument code provides information on maturity date and average interest rate.

For the purposes of the analysis, I classified each of the 2,422 financial instruments following an approach matching the quarterly data set. However, the more granular information allows for additional subcategories. For the issuer information, the data set adds large bank, mid-tier bank, small bank, central government, and public entity. For the maturity information it adds term to maturity, which is not in the industry data set.

Additional data was obtained from the South African Reserve Bank, both from the Bank Supervision Department which publishes data on liabilities of supervised banks; annual reports and trading updates from African Bank Investment Ltd and African Bank Ltd.[21] This data was complemented with data published by the funds themselves, including fund 'fact sheets' – however, these sheets do not always contain detailed information on fund holdings.[22]

4.5.4 Exposure to African Bank

The estimate of exposure to African Bank was obtained in two ways. The first way was an analysis of the regulatory returns, which provide a detailed picture of the exposure of each fund to different instruments. The second was to calculate the exposure by considering the size of the retention funds set up by each fund. The two ways yield broadly comparable results – however, due to inconsistencies in

[21] http://africanbank.investoreports.com/ and from the Treasury division of the bank.

[22] See, for example, the June 2014 Stanlib statement which does not disclose the African Bank holdings, despite the fact that it was a larger proportion of its holdings than other holdings, which were disclosed.

Table 4.4: Summary statistics, financial-instrument level data

Category	**Number**		**Mean**		**Days-to**	**Coupon**
	Issuers	*Instruments*	*Jun-14*	*Sep-14*	**Maturity**	*%*
Large Bank	4	787	31,762	28,784	197	8.2%
Mid-tier bank	3	120	11,060	14,124	30	5.8%
African Bank	1	53	18,260	457	53	7.8%
State-owned entities	23	192	46,366	41,958	96	8.9%
Sovereign	1	115	40,5068	60,074	115	6.0%
Derivatives	16	270	9,220	8,149	269	6.3%
Non-bank	157	881	15,028	14,892	881	8.2%
	205	2418	24,601	24,063	234	7.3%

Source: Quarterly data set (see text)

the way funds report to the regulator, the second approach was preferred. Where funds did not set up retention funds, the first approach was used.

4.5.5 Data cleaning and reconciliation

Two adjustments had to be made to the data: retention funds and double-counting. Some funds created retention funds at the time of the failure. These retention funds caused an automatic reduction in the size of the fund, as the assets were held in a separate fund. The effect is to overstate the reduction in the size of the fund. The second concern is double-counting – money-market funds by definition buy high-yield short-term instruments. These are sometimes simply units[23] in other money-market funds. This is most notable for yield-chasing funds of funds, typically actively managed funds that merely aim to keep a portfolio of, for example, the ten highest yielding money-market funds. As far as possible, data without double-counting was used.

[23] A 'unit' is an holding in a collective investment scheme or a money-market fund, similar to a 'share' in a company. (Originally these were 'unit trusts', i.e. trusts that had been unitised). In the case of a money-market fund, a unit maintains its value at 1.

4.5.6 Were funds with African Bank exposure different ex ante?

Table 4.2 presents summary statistics of interest-bearing funds grouped by type (money-market or income) and exposure to African Bank on 30 June 2014, prior to the event.

On average, money-market funds with African Bank exposure were larger than funds without exposure. The 14 money-market funds with exposure had an average net asset value of R 15.9 billion, compared to the 23 without exposure of R 3.1 billion.

Returns, however, were larger in non-exposed money-market funds (see Table 4.3). Non-exposed money-market funds had an annual yield (weighted by fund size) of 5.23 per cent, compared to a yield of 5.11 per cent for exposed funds, and a yield of 5.18 per cent for all funds.[24]

A further measure of the riskiness of the portfolios is in the holdings of underlying instruments. Table 4.2 presents both instruments and maturities using the quarterly data set.

The high exposure to financial corporations is evident. Money-market funds, in particular, show very high exposure to financial corporations. Average exposure of money-market funds to financial corporations was 95.1 per cent, mainly deposits (35.9 per cent), debt instruments (31.0 per cent), and unlisted instruments (28.2 per cent). All exposures to African Bank amounted to 1.1 per cent.

4.6 Results

4.6.1 The impact on money-market funds

In this section, the impact on mutual funds following the bail-in is analysed. From a simple examination of the daily data (see Figure 4.1), it is immediately apparent that there were large-scale redemptions of investments in money-market funds. On average, African Bank made up approximately 1.1 per cent of the holdings

[24] This yield may appear high – however the corresponding inflation rate for the period was 6.59 per cent.

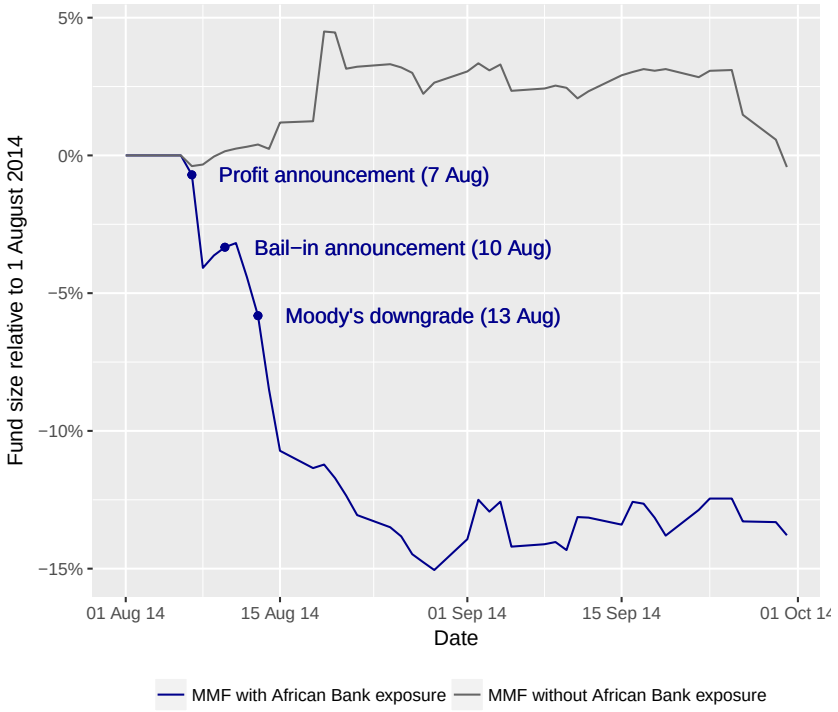


Figure 4.1: Cumulative money-market fund redemptions

Redemptions were concentrated in money-market funds with African Bank exposure. Redemptions began shortly after the adverse profitability announcement, and accelerated after the bail-in and Moody's downgrade.

of money-market funds. Within three weeks, money-market fund redemptions reached R32.4 billion, or 11.8 per cent of the size of all money-market funds. The redemptions were concentrated in money-market funds with exposure to African Bank, where clients redeemed 15 per cent of their holdings. The profitability signal precipitated the beginning of redemptions. Once the bail-in was announced two days later, redemptions accelerated. They continued as Moody's downgraded the credit rating of the bank on Wednesday, August 13, the second time in a year.

4.6.2 Redemptions controlling for fund heterogeneity

It is possible that the large observed money-market and income fund redemptions may reflect other differences between the funds, and not be directly attributable to exposure to African Bank. The related literature showed that overall riskiness, maturity structure and nature of investors (uninformed or informed) may influence redemptions following a shock. Funds with a variable NAV, for example, are theoretically more robust in the face of shocks.

There is sufficient data in the quarterly data set to control for the observed heterogeneity between mutual funds, in terms of size, investment strategy, holdings, maturity structure, and variable NAV versus constant NAV.

For the first analysis, I use a full sample of 74 mutual funds, with equal time periods before and after the event. Both money-market and income funds are included, and in subsequent sections the behaviour of these two kinds of funds will be analysed separately.

The first model specification is:

$$\Delta LogFundSize_t = \beta_0 + \beta_1 X_{t,j} + \beta_2 T_{t,j} \tag{4.1}$$

where $\Delta LogFundSize_t$, is the one period change in the log fund size, $X_{t,j}$ is a vector of mutual fund characteristics j at time t, and $T_{t,j}$ is a vector of treatment dummies that evaluate the statistical significance of various treatments. It is widely documented[25] that fund flows are determined by returns. That is, funds with higher returns experience greater inflows all other things being equal. Using fund returns directly is problematic, however. Fund returns are likely to be confounded with exposure to African Bank, in particular as the return on African Bank instruments was higher than other instruments. For this reason, I proxy fund returns using maturity and types of exposure to instruments. Two maturity measures are included: a measure of the share of short-dated instruments (*ShareShort*), which is a proxy of the portfolio allocation to instruments of duration less than 6 months) and the change in maturity (Δ *Maturity*). I also include the share of exposure to government bonds (*ShareGovi*) and in an alternative specification add

[25] See, for example, the discussion in Kacperczyk and Schnabl (2013) or Cici et al. (2017)

in a measure of the share of assets in cash instruments (*ShareCash*).

The treatment effects take the form of three dummy variables: *BailIn* tests for the effect of the bail-in, and takes the value of 0 for the period before the bail-in and 1 for the periods after. *AfricanBank* takes the value of 1 for funds with exposure to African Bank.[26] *MMF* takes the value of 1 if the fund is a money-market fund.

Results

Table 4.5 presents the results of an analysis using panel treatment effects. The results confirm the initial analysis presented in Figure 4.1.

In specification (1), the coefficient on short-dated maturity is positive, suggesting that funds with relatively higher shares of assets in short-dated instruments experience larger flows on average. Similarly, the change in maturity is also positive. This may reflect the corollary of Gorton et al. (2014)'s 'flight from maturity' effect – as funds grow, their maturity lengthens.

The treatment dummies are also of the expected size and effect. The African Bank measure is positive and statistically significant – as observed in Table 4.2, typically larger funds had exposure to African Bank.

Most notably, the triple interaction term for bail-in, African Bank and money-market fund is negative and statistically significant. This supports the hypothesis that money-market funds with African Bank exposure experienced larger outflows following the shock, even after controlling for other fund characteristics. It does not necessarily follow that income funds were completely unaffected – I will examine this question in more detail below. Interestingly, the dummies for bail-in and money-market funds are individually not statistically significant in this specification, but become so in specification (4) discussed below. This is consistent with the observed flows – only African Bank-exposed funds experienced large redemptions.

Robustness and econometric tests

In specification (1), the analysis considered the change in the size of the fund. However, at the time of the bail-in, funds could elect to transfer their African

[26] Due to multi-collinearity in the final regressions, an alternative of share of African Bank exposure was also used.

Table 4.5: Did exposure to African Bank determine redemptions?

	Dependent variable:			
	Δ Log Fund Size	Δ Log Fund Size (Adj.)*a*		
	(1)	(2)	(3)	(4)
Share: short maturity (<6mth))	2.051***	2.052***	2.087***	2.040***
	(0.463)	(0.464)	(0.468)	(0.201)
Δ Maturity	0.171***	0.171***	0.175***	0.177***
	(0.038)	(0.038)	(0.038)	(0.013)
Share: Cash				−0.498*
				(0.270)
Dummy: Bail-in	0.073	0.074	0.085	0.083
	(0.059)	(0.059)	(0.059)	(0.203)
Dummy: African Bank*b*	0.275	0.271	0.274	0.249*
	(0.226)	(0.226)	(0.223)	(0.133)
Dummy: MMF*b*	−0.00004	−0.00004	−0.00005	−0.0002
	(0.0001)	(0.0001)	(0.0001)	(0.0002)
Dummy: Bail-in *x* Afr Bank	−0.069*	−0.065*	−0.071**	−0.160***
	(0.036)	(0.036)	(0.035)	(0.049)
Dummy: Bail-in *x* MMF	−0.208	−0.209	−0.226	−0.206
	(0.172)	(0.172)	(0.176)	(0.302)
Dummy: Afr Bank *x* MMF	−0.376	−0.378	−0.404*	−0.353
	(0.233)	(0.233)	(0.231)	(0.392)
Dummy: Bail-in *x* Afr Bank *x* MMF	−0.670**	−0.670**	−0.775***	−0.732*
	(0.266)	(0.266)	(0.274)	(0.405)
Fixed effects:	fd=Fund	fd=Fund	fd=Fund	fd=Fund
Observations	507	507	500	469
R^2	0.273	0.273	0.280	0.306
Adjusted R^2	0.261	0.261	0.268	0.292
F Statistic	21.920***	21.890***	22.343***	21.245***

Note: *p<0.1; **p<0.05; ***p<0.01

This table presents the results of panel fixed effects (first difference) regressions. The dependent variable is the one-period change in the log size of mutual funds.

† Adjusted for retention funds. Retention funds are added back to the original fund.

‡ Instrumental variables - for money-market fund: exposure to instruments over 1 year, and for African Bank exposure: share of African Bank exposure.

⋄ As noted in Table 4.7, the null of serial correlation in residuals cannot be rejected for specifications (1), (2) and (3). Robust standard errors are adjusted following MacKinnon and White (1985); Arellano (1987).

Table 4.6: Concentration of holdings

	Exposure	% of fund	% of all MMF
ABSA money-market fund	R 1 677 m	3.3%	56.9%
Stanlib money-market funds	R650 m	2.6%	17.3%
Investec money-market fund	R270 m	1.0%	9.2%
Momentum money-market fund	R95 m	1.1%	3.2%
Other (9 funds)	R254 m		8.6%
Total	R2 945 m	1.00%	100%

Source: as above, and fund fact sheets

Bank exposures to a retention fund. Only a limited number of funds elected to transfer, but it is possible that the transfer may bias the results by overstating the size of the redemptions in the fund. For this reason, in specifications (2), (3) and (4), the dependent variable is the size of the fund adjusted for retention funds. The effect on the estimated co-efficients is small. Notably the estimated coefficient on the triple interaction term is unchanged at three decimal places.

The second concern is the observed concentration of holdings (Table 4.6). The ABSA money-market fund, South Africa's largest, accounted for 57 per cent of all money-market fund exposures to African Bank, or R1.677 billion. This may appear large, but the ABSA money-market fund was valued at R51.1 billion in early 2014, and so the African Bank holdings account for only 3.3 per cent of the fund. Together 91.4 per cent of money-market fund exposures were concentrated in five money-market funds.

To test whether or not there is an impact, in specification (3) I exclude the largest fund from the data sample. The results suggest that the single fund does not drive the results, but there are some changes to the magnitude of the result. Interestingly, the coefficent on the triple interaction term becomes more negative. This suggests that excluding the largest fund does change the results, albeit not substantially.

The largest fund is also relatively unique in that it is almost entirely (99 per

cent) invested in cash instruments.[27] This is in marked contrast to other MMFs, which maintain approximately 11 per cent in overnight cash-type instruments. This may further bias the results. To take this into account, in specification (4), the regression excludes the largest fund, and includes a measure of the share of cash (*ShareCash*).[28]

In specification (4), the double interaction term of bail-in and African Bank becomes more negative and statistically significant. This may suggest that all mutual funds with African Bank exposure experienced some outflows. However, the triple interaction term remains negative and significant, indicating that money-market funds still experienced larger outflows.

Panel econometric tests

I test for variable stationarity to ensure that panel co-integration effects are not present. The dependent variable, $\Delta LogFundSize_t$, is found to be stationary. The statistical tests reject the null of a unit root.

Table 4.7: Panel econometric tests

	Dependent variable:			
	Δ Log Fund Size	Δ Log Fund Size (Adj.)†		
	(1)	(2)	(3)	(4)
Hausman test	p<2.2e-16	p<2.2e-16	p<2.2e-16	p<2.2e-16
F test	p = 0.1513	p = 0.4875	p = 0.2573	p = 0.1808
Breusch-Godfrey Wooldridge χ^2	8.9376 p=0.01146	8.9359 p=0.01147	9.1512 p=0.0103	5.3522 p=0.06883

[27] Its African Bank holdings were also in overnight negotiable certificates of deposit, which are classified as cash for the purposes of the statistics, and were also bailed in.

[28] For brevity, full econometric tests are not reported here. Tests were conducted to evaluate whether there are unidentified fund-specific characteristics, and these indicated that a fixed-effects panel is appropriate. The nature of the specification is first differences, due to the presence of serial correlation effects as borne out by a Wooldridge test. The existence of potential cointegration effects is reduced by the specification method. That said, we find no evidence of a unit root in the dependent variable.

I conduct a number of tests on the specification, reported in Table 4.7.

The first test considered is the Hausman phtest, which tests for the presence of fixed effects. Fixed effects are essentially group dummies, where particular groups of observations may have a different intercepts. In this case, there is an *a priori* case that each fund should have a set of unobservable characteristics. The null is that there are no fixed effects (i.e. that there are random effects), with the alternative hypothesis of fixed effects. This test compares the unique errors (u_i) are correlated with the regressors. For each specification reported in Table 4.5, a random effects version of the model was run, and compared to the reported fixed effects model. Across all cases, the Hausman test p-value is reported as below 0.01, indicating that the null of random effects should be rejected. A related test is an F test for time effects, estimated using the `pFtest` function. In this case, the null is that there are no time fixed effects needed. The reported p-values indicate that the null should not be rejected, indicating that one can proceed without time effects (Torres-Reyna, 2010, 18).

A more serious concern is the results of the Breusch-Godfrey/Wooldridge test, where the null hypothesis is no serial correlation in the idiosyncratic errors (`pbgtest`). This may bias the standard errors. The null is rejected for specifications (1), (2), and (3), suggesting the presence of possible serial correlation. As a result, new robust standard errors are calculated, following MacKinnon and White (1985); Arellano (1987). Table 4.5 contains the robust standard errors. For specification (4), the null is not rejected at the 5 per cent confidence level. Consequently, I do not adjust the standard errors.

4.6.3 How did money-market funds respond to the event?

Daily redemption patterns - money-market funds and other funds

In the week after the bail-in announcement, total money-market fund redemptions were 6.7 per cent, whereas money-market funds with African Bank exposure had redemptions of 8 per cent and those without exposure actually saw small inflows. Within a month, redemptions in African Bank-exposed funds reached nearly 15 per cent. If we express the redemptions in absolute terms, there was a total outflow from money-market funds of R 32.4 billion, and assets under management fell from

R 271.3 billion to R 241.5 billion, or approximately 11.8 per cent.

By 30 September 2014, the end of the reporting quarter, total redemptions from money-market funds were R32.4 billion, with assets under management falling from R 271.3 billion to R 241.5 billion, or approximately 11.8 per cent of the industry. We can estimate where the money went by looking at the monthly banking statistics.[29] It appears that institutional investors moved money to banks, with the deposits in banks from these investors rising to R24 billion from R16 billion, an increase of R8 billion, or 50 per cent. There were inflows into banks from households and pension funds, although smaller. In addition, flows to equity funds and multi-asset funds also rose.

If one considers that the outflow was approximately 11 times the size of the entire money-market fund exposure to African Bank, it is clear that there was a significant flow.

Table 4.8 presents an analysis of the behavior of different money-market funds controlling for fund and investor characteristics. This gives an indication how different characteristics affected fund flows differently. Of the outflow, the majority was due to institutional investors (outflows of R23.3 billion) compared to retail investors (R9.1 billion). Moreover, investors acted (relatively) rationally. The 14 portfolios with exposure to African Bank were most affected – losing R30 billion; whereas the 29 portfolios with no African Bank exposure only lost R2.1 billion. Here institutional investors also responded as expected indicating some knowledge – they withdrew very little from funds with no African Bank exposure. This suggests that improved information had a substantial (and expected) result on run behaviour. Fourteen funds with African Bank exposure experienced outflows. These outflows also averaged 11x the size of the African Bank exposure. The largest outflow from one fund was 24x the exposure to African Bank; and the smallest was 2x the exposure.

These results could be explained in part by a somewhat unintended consequence of the retention funds. Creating the retention fund immediately highlighted that the relevant fund had exposure to African Bank – possibly this explains why so few money-market funds actually used retention funds. Nevertheless, the four funds that chose to use retention funds had R21.9 billion in outflows; equivalent

[29] Obtained from the Bank Supervision Department of the South African Reserve Bank.

Table 4.8: Which types of money-market funds saw inflows and outflows?

Controlling for:	n	Inflow + / Outflow -	Flow as % of fund
No control (all funds)	37	- R32.8 billion	-12.6%
Portfolios experienced outflows	21	- R37.4 billion	-14.4%
Portfolios experienced inflows	16	+ R4.7 billion	1.8%
Investor type			
Institutional investor	37	- R23.3 billion	-9.0%
Retail investor	37	- R9.1 billion	-3.6%
Exposure to African Bank			
Exposed	14	- R30.1 billion	-11.6%
Not exposed	23	- R2.7 billion	-1.0%
Exposure to ABL & Investor			
Institutional | ABL	14	- R22.2 billion	-8.6%
Institutional | No ABL	23	- R1.1 billion	-0.4%
Retail | ABL	14	- R7.5 billion	-3.0%
Retail | No ABL	23	- R1.6 billion	-0.6%
Retention fund			
Retention fund / sponsor support	4	- R21.9 billion	-8.4%
No retention fund	33	- R8.2 billion	-4.2%

Source: Industry data set (see text).

to 9x their holdings in African Bank. In contrast the 9 funds that chose not to experienced R8.2 billion in outflows, equivalent to 16.6x their African Bank holdings.

4.6.4 How did income funds respond to the event?

Income funds experienced the African Bank episode very differently from money-market funds. I disaggregate changes in income funds into two effects. The first effect is the price effect, i.e. changes to the NAV of income funds. The second effect is the redemption effect, i.e. changes to income funds due to withdrawals. I consider both effects below.

Impact on income-fund NAVs

To better understand the impact on NAVs, Figure 4.2 presents the income fund NAVs over the course of the bail-in episode. The figure shows that income fund NAVs adjusted downwards ahead of the bail-in event. This was because income

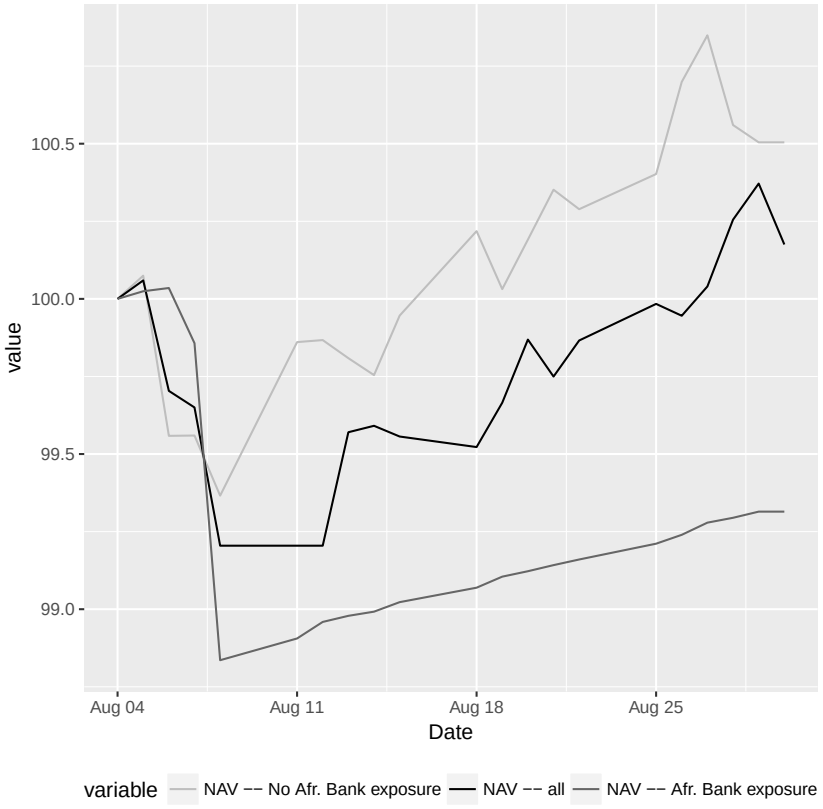


Figure 4.2: Income fund NAVs

Revaluation effects led to NAVs falling for African Bank-exposed income funds. NAVs fell during the week prior to the bail-in as bond prices fell, and then recovered as the value of other instruments in the portfolio improved.

funds registered losses as the mark-to-market price of African Bank instruments deteriorated.

However, the NAVs of non-exposed funds also fell. This suggests there may be broader confounding market-wide effects unrelated to African Bank. To test this, I use an adapted version of the standard Fama-Macbeth model to calculate the deviation of returns for exposed and unexposed funds relative to all income funds.

$$R_{it} - R_{ft} = a_i + \beta_i(R_{Mt} - R_{ft}) + e_{it} \tag{4.2}$$

In this regression, R_{it} is the daily return (including changes to NAV) on fund

i for day t, R_{ft} is the riskfree rate (the overnight South African Treasury rate), R_{Mt} is the the return on all income funds, a_i is the average return left unexplained by the benchmark model (the estimate of α_i), and e_{it} is the regression residual. We can compare the estimate of a_i for income funds with African Bank exposure to that of income funds without exposure. The estimate (see Table 4.9) is that return for income funds with African Bank exposure relative to the benchmark was -0.5974, with a standard error of 0.1356. For income funds without exposure, the estimate is 0.212 with a standard error of 0.098. This shows a significant underperformance for African Bank income funds over the period.

Table 4.9: Fama-Macbeth results

	Dependent variable:	
	Income fund: African Bank exposure	Income fund: no African Bank exposure
	(1)	(2)
β	0.722**	0.654***
	(0.286)	(0.206)
α	−0.597***	0.212**
	(0.136)	(0.098)
Observations	21	21
R^2	0.251	0.347
Adjusted R^2	0.212	0.312
Residual Std. Error (df = 19)	0.372	0.268
F Statistic (df = 1; 19)	6.367**	10.076***
Note:	*p<0.1; **p<0.05; ***p<0.01	

Impact on income-fund redemptions

There is evidence that income funds also experienced redemptions during the period. The econometric results presented in Table 4.5 indicate that income funds

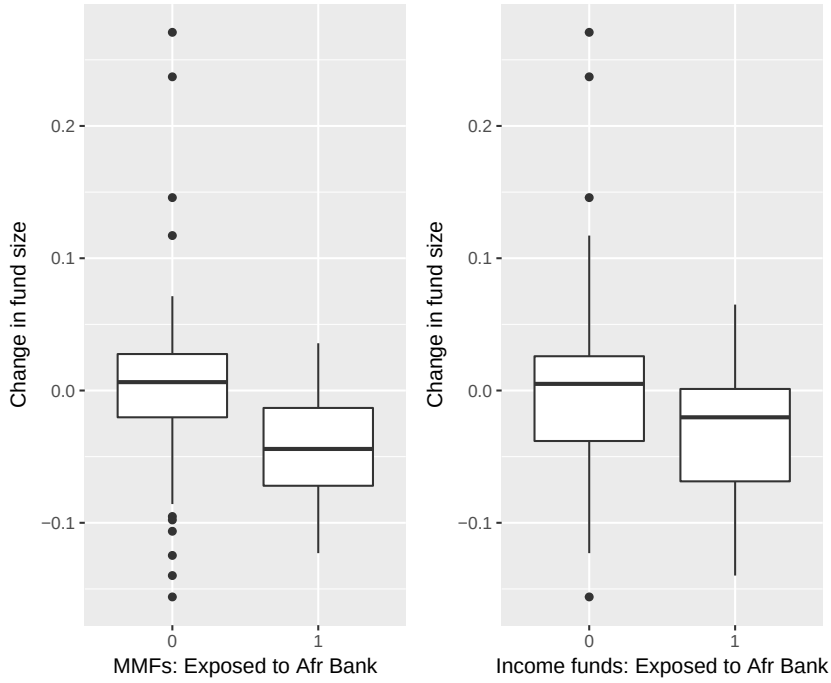


Figure 4.3: Redemptions in exposed money-market funds compared to income funds

Affected money-market funds experienced large and statistically significant outflows. While there were outflows in affected income funds, these are not found to be statistically significant. For the relevant ANOVA tests, see Table 4.10

were, however, less affected by the shock than money-market funds. A variety of techniques were used to test for whether or not there is a statistically significant outflow. Limited indications of an impact are found, partly evidenced by the box-and-whisker plots presented in Figure 4.3, and confirmed with the ANOVA tests presented in Table 4.10. The ANOVA test presents the null hypothesis of no statistical difference in flows. For money-market funds, the null is rejected at a 5 per cent confidence level. In contrast, for income funds, the null is not rejected.

4.6.5 Portfolio reallocation and spillover effects

The previous section analysed how investors into mutual funds behaved, noting that there were significant redemptions. But how did the funds respond - i.e. what

Table 4.10: ANOVA test for exposed money-market and income funds

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MMF - with ABL exposure	1	0.02	0.02	4.02	0.0487*
Residuals	71	0.35	0.00		
Income fund - with ABL exposure	1	0.01	0.01	1.44	0.2341
Residuals	71	0.36	0.01		

did asset managers do? Significant portfolio rebalancing could trigger spillovers, particularly if the rebalancing precipitated large-scale sales of financial instruments in other banks.

The connection between non-bank financial institutions, such as mutual funds and pension funds, and banks is particularly close in South Africa – in 2013, approximately 33.6 per cent of bank liabilities were to these other financial intermediaries; in contrast the global average was 4.9 per cent in the same year.[30] By March 2016, the South African mutual fund industry had approximately R1.7 trillion of assets under management, or 68 per cent of nominal gross domestic product (GDP). As a comparator, retail bank deposits were approximately R912.5 billion, or 36 per cent of GDP.

The size of the mutual funds potentially magnifies the potential for spillovers and arises through the channels discussed above – common exposures, hoarding, a cascade of defaults or through opaque interlinkages between money-market funds and banks.

At aggregate level

The industry data set shows evidence of rebalancing of holdings in financial institutions. Income funds (see Table 4.11) reduce their exposure by 12.9 per cent. Money-market funds increase their exposure to financial institutions, by 2 per cent.

A related effect is a change in maturities. Table 4.12 shows the allocation across different maturities for money-market funds. There was a marked fall in allocation to cash, from R27.3 billion to R18.7 billion. This may reflect the need to fund the

[30] Statistics in this section are from Financial Stability Board (2015) and the industry data set.

Table 4.11: Mutual fund exposure to financial institutions

Type of fund	June	Sept	% change
Income funds	57.8	50.3	-12.9%
Money-market funds	72.0	73.4	2.0%
All funds	129.8	123.8	-4.6%

Note: Aggregate holdings of instruments issued by 'financial institutions'.

large redemption requirements that came through. However, there was a rise in allocations to short-term (0-3 month) instruments, typically short-term deposits. Allocations to this category rose from R107 billion to R114 billion, or from 39.6 per cent of the portfolio to 47.6 per cent of the portfolio. But the main effect is at the longer maturities. The allocation in the 3-6 month category fell from R72.9 billion (or 26.9 per cent) to R51.4 billion (or 21.3 per cent). Holdings longer than six months were also reduced from R63.6 billion to R56.0 billion.

Table 4.12: Change in maturity profile, money-market funds

	June		Sept	
	R m	%	R m	%
Cash	27 303	10.1%	18 791	7.8%
0-3 Months	107 492	39.6%	114 919	47.6%
3-6 Months	72 891	26.9%	51 436	21.3%
$>$ 6 Months	63 616	23.5%	56 008	23.2%
Total	271 301	100%	241 154	100%

Note: This table uses the industry data to show how the aggregate maturity of MMFs changed from the quarter before and after the bail-in.

Portfolio rebalancing at a financial instrument level

The data set on allocation to financial institutions data is somewhat misleading, as it includes insurers and other non-bank financial institutions. It may not, for example, capture a rebalancing of the portfolios away from banks towards non-bank financial institutions. The observed lengthening of maturities also does not necessarily capture the nature and type of reallocations between different types of instruments. To better understand these dynamics, the data at financial instrument level is more appropriate.

To test the effects at a financial institutional level, banks are classified into three categories: 'Big Four', which are the four largest South African banks (Barclays Africa / ABSA, Standard, FirstRand and Nedbank); Small and mid-tier banks (Investec, Capitec and Sasfin) and African Bank. Sovereign debt instruments are instruments issued by the national government. Public entity debt is issued by both sub-national sovereigns and state-owned entities (including municipalities, large national state-owned entities and smaller regional entities, such as water boards).

Table 4.13 summarises the results. In this sample, total mutual-fund redemptions are 3.3 per cent. There are marked rebalancing effects, however, showing that fund managers actively sought to reduce exposure to bank-issued debt, in favor of safer sovereign-issued debt. Exposures to Big Four banks debt reduce from R24.4 billion to R22.2 billion, a decline of 9.1 per cent. This suggests significant potential spillover effects.

Potential for a market freeze

The notable decline in exposures to large banks highlights that a key concern during the resolution was the potential for a market freeze in short-term paper. At end July 2014, the big four banks had 4.6 per cent of their liabilities from mutual funds. There was a notable decline in funding from mutual funds from R119.3 billion to R110.0 billion between end July and end August 2014, over the period of the resolution.

This was in financial instruments with a duration of less than 30 days, typically negotiable certificates of deposit (NCDs). Of these instruments, 36 per cent were

Table 4.13: How did mutual funds rebalance their portfolios?

Exposure to (Rand billion)	June 2014	Sept 2014	Change	%
'Big Four' bank	24.4	22.2	-2,2	**-9.1%**
Small and mid-tier bank	2.0	2.1	0.8	3.9%
African Bank*	1.0	0.0	-0.9	-97.5%
Sovereign	4.7	6.9	2.2	**48.3%**
Public entity	7.5	6.9	-0.6	-7.5%
Derivative	2.3	2.1	-0.2	-6.8%
Non-bank corporate	13.6	13.4	-0.3	-1.9%
Total	55.5	53.7	-1.8	-3.3%
Total (ex African Bank)	54.5	53.6	-0.9	-1.6%

Almost all holdings in African Bank were restated.
This table uses the regulatory data set to identify how money-market fund asset allocation changed over the time of the bail-in announcement. The largest changes are highlighted in **bold**: a reduction in allocations to big-four banks and an increase in allocation to risk-free and liquid sovereign paper (48% increase). The data set is a representative sample, and is approximately 20% of the full data set.

held by money-market funds. As highlighted above, arrangements were made to ensure that there was no freeze in the market for these instruments.

Liquidity conditions can be proxied by short-term interest rates. In Figure 4.4, the evolution of the spread between the central bank overnight rate and the 90-day NCD rate is presented. There is a clear indication of some stress as rates rose. Moreover, there were knock-on effects. In the two weeks directly after the bail-in, three corporates cancelled bond issuances due to adverse market conditions: Real People Investments (a small bank), Toyota and BMW (the local subsidiaries of the automakers).

4.6.6 Long-term outcome

Ultimately, African Bank was successfully restructured. By August 2017, three years after the bail-in, the bank had resumed profitable lending. The 'stub' claim, created at the time of the bail-in, was trading at 66 per cent of par. Essentially

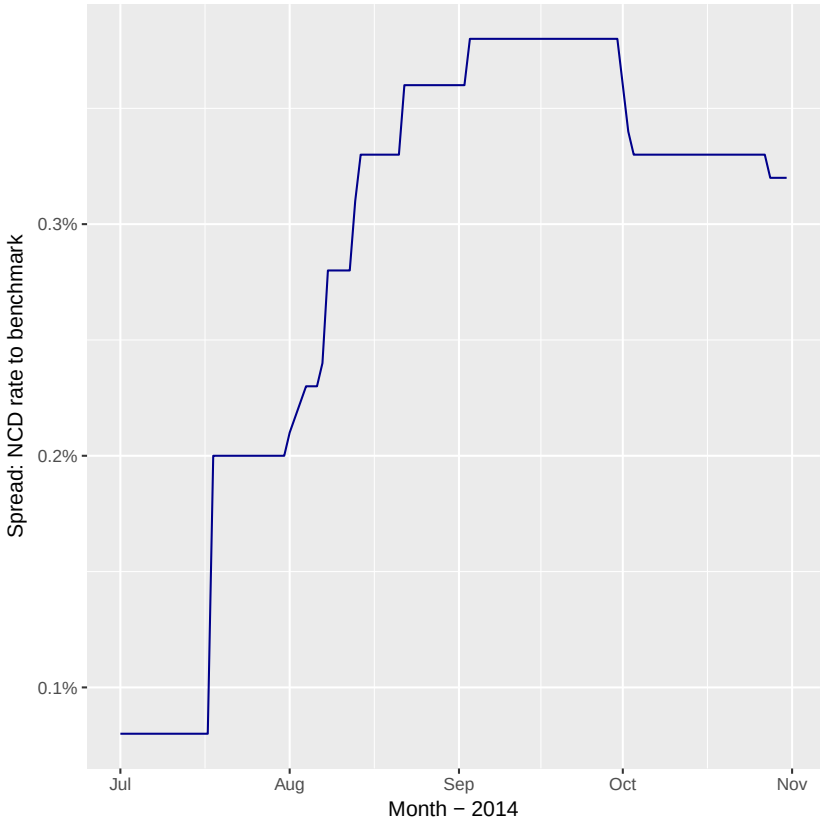


Figure 4.4: Spread between bank NCD rate and overnight rate

The spread between the prevailing rate on negotiable certificates of deposits issued by banks and the benchmark rate widened over the course of the bail-in. Interviews with market participants reveal a substantial tightening of market conditions. Three non-bank financial institutions were forced to cancel bond issuances, and bond issuances for banks became more expensive.

the majority of the bail-in had been recovered as the profitability of the bank improved. The bail-in arguably provided an opportunity for the authorities to stop the further deterioration of the bank, recapitalise it by writing off creditors' claims, and restore its ability to undertake business.

4.7 Conclusion

Policymakers are increasingly relying on bank resolution strategies that seek to impose losses on creditors. Using a unique event, this chapter analyses the effects

of one such resolution on money-market funds.

The immediate result was that all affected money-market funds 'broke the buck'. This triggered large redemptions. Nevertheless, there was a limited impact on the financial system. There was a small but notable reallocation (3.6 per cent) of funds away from non-cash financial instruments issued by other banks toward government-issued instruments. Over the course of six weeks, the maturity of money-market fund holdings also changed – there was a decline in cash balances at large banks and a marked shortening of maturities. However, these effects were managed through complementary actions, including market-making facilities to ensure liquidity.

There are lessons for bail-in frameworks. The impact on creditors may create additional financial fragility, particularly when creditors are uncertain about their exposure to the bank being bailed in. Systemic runs may also occur when the failure is not believed to be idiosyncratic, leading creditors to believe that bail-ins may follow in similar banks.

If the authorities had not announced a credible haircut, or if the communication on the plan had been vague, the withdrawals from money-market funds may well have been larger, and the rise in redemptions may well in turn have led to the large-scale withdrawals of funds by money-market funds from other banks, precipitating a more generalised run. Money-market funds also responded differently depending on whether gating occurred – funds that chose to use retention funds had relatively smaller outflows.

The analysis challenged some of the conventional wisdom about the interaction between wholesale funding and banks. The first is that wholesale funding is more prone to runs than retail funding. Indeed, the experience of African Bank showed the contrary. It was predominantly funded by long-dated wholesale funding, and this arguably reduced the risk of a sudden run on the bank. Indeed, it seems that wholesale funders slowly reduced their exposure to African Bank by not rolling over their maturing instruments.

In this case, the bail-in was arguably successful. A failing bank could be partly recapitalised through imposing losses on creditors. Appropriate complementary actions, such as discretionary liquidity restrictions and market-making facilities for short-term paper arguably mitigated further spillovers. The African Bank

experience suggests that if carefully implemented, bail-in can support a bank resolution that shares the financial burden between strained fiscal authorities and creditors.

Chapter 5

Conclusion

Bank failures can have significant economic, financial, political and social consequences. Against the background of the international literature, this study draws lessons from South African bank failures between 2002 and 2014. In each individual chapter, lessons from specific episodes were drawn. In this concluding chapter, the focus is on broader, cross-cutting lessons.

5.1 Economic and financial lessons

The significant economic and financial costs associated with bank failures underscore the need for strong financial regulation and supervision, a robust financial stability framework, and appropriate resolution tools.

During the small bank crisis of 2002 to 2003, twenty-two banks closed over two years, with significant broader macroeconomic effects. The consolidation of the banking sector led to substantially reduced competition. During and after the crisis, money supply growth slowed, and liquidity declined. The central bank's balance sheet shrunk by a third, from R150 billion to R100 billion, and overall credit extension growth declined from a three-year high of 15.7 per cent in January 2002 to 11.7 per cent by July of that year. The slowdown in lending experienced during the first half of 2003 was particularly noticeable in corporate lending, where many of the failed banks specialised.

The study also highlighted financial market spillover effects. Distress can

rapidly spread from one bank failure to others. The small bank crisis shared a number of features with 'bank panics' in other jurisdictions, in that the spillover effects were to other small banks. The chapter demonstrated that this contagion was through neither overlapping claims nor through information effects. Rather, there was a general loss of confidence in smaller banks. Banks with more fragile liability structures, i.e. with short-term wholesale funding, experienced runs. Even well-capitalised banks with short-term funding structures failed.

Chapter 4 demonstrated that spillover effects could take place through non-bank financial institutions. This was a key lesson of the 2008 global financial crisis – when Reserve Primary Fund, a money market fund, broke the buck on 16 September 2008, it contributed to significant damage throughout the financial system. During the African Bank failure, over fifteen money-market funds broke the buck and there was a brief run on money market funds. The spillovers were similar, but substantially more muted.

5.2 Lessons for macroprudential policy

Bank failures impose costs but bank regulations themselves also have economic consequences – both costs and benefits. Chapter 3 showed that changes to banking regulatory measures, in this case system-wide capital requirements, have macroeconomic and financial stability implications. This was an early use of a 'macroprudential' tool – a microprudential regulatory tool used with a broader financial stability goal. The increase in capital adequacy dampened credit growth and strengthened bank balance sheets, fortuitously ahead of the significant external shock of the global financial crisis. This demonstrated the usefulness of macroprudential tools, particularly the countercyclical capital buffer, in situations where monetary policy tools are either ineffective or inappropriate.

Macroprudential tools should also be used within a coordinated framework. For the pre-2008 period, I showed that the decision to increase capital adequacy ratios was undertaken by the banking supervisor. An analysis of the minutes of the monetary policy committee and the Monetary Policy Review reveal that the far-reaching implementation of Basel 2, including the increase in capital adequacy, was not discussed as a monetary policy issue. Similarly, in chapter 2, I showed

that institutionally, the Reserve Bank's own analysis of the 2002/3 small banking crisis shows that it was viewed as primarily a banking crisis and not a monetary policy one. The response during the African Bank failure was substantially better – all divisions of the central bank supported the resolution. Liquidity was made available to the system; supervision was enhanced on other banks, and there were no disruptive interest-rate changes.

There is a lesson in this for the institutional structure of a central bank. The monetary policy setting, monetary policy implementation, banking supervision and financial stability functions are not wholly separable functions, but components of a broader central banking function. As the central bank moves towards operationalising an explicit financial stability goal, this suggests that monetary, macroprudential and microprudential policy should not be treated as clearly delineated, separate areas of central bank policy, but rather as a co-ordinated set of tools.

5.3 Lessons for monetary policy

The study demonstrated that monetary policy and financial stability are not mutually exclusive – the stance of monetary policy may often have non-neutral effects for financial stability.

Credit growth is a well-established warning sign of financial instability. Chapters 2 and 4 highlighted that rapid credit extension in unsecured loans preceded both the failure of Saambou and African Bank. In the year preceding the small bank crisis, unsecured personal loans grew by 26.7 per cent per annum; whereas in the year ahead of the African Bank failure, unsecured loans grew in excess of 10 per cent per annum. Both Saambou and African Bank experienced rapid growth in loans. A year before its distress became evident, Saambou's assets grew by 34.8 per cent. Similarly, African Bank's peaked at 50 per cent per annum.

In chapter 3, I showed that in the years leading into the global financial crisis, monetary policy and macroprudential policy pulled in different directions. On the one hand, the central bank reduced the overnight policy rate. On the other, it raised capital adequacy requirements. The former almost certainly contributed to rapid growth in credit extension and house price growth, which rose 17.5 and 20.2

per cent year-on-year on average between 2002 and 2007.

During all three periods, the Reserve Bank communicated that it was unconcerned about the rapid rise in credit. The argument was that inflation remained low and so a response within the context of a strict 'Greenspan Standard' inflation-targeting framework was not required. During the lead-up to Saambou and African Bank, there was no macroprudential response – the central bank could have, for example, raised capital requirements for unsecured loans to dampen this particular type of lending. Or it could have raised overall capital adequacy requirements to dampen all lending.

As discussed in chapter 3, for small open economies, monetary policy may also have mixed effects on credit growth. Increased interest rates may stimulate capital flows, which would support domestic credit growth. In this scenario, macroprudential policy is a better tool to manage financial stability effects as it has limited exchange rate and open economy effects.

5.4 Lessons for responding to failures

The study demonstrated that when banks fail, authorities need a clear and credible plan.

In each of the periods, the authorities chose a different approach, providing an opportunity to compare. During the small bank crisis, the policy response to the runs was inappropriate. While unlimited solvency and liquidity support was given to the largest failing bank, BOE, a set of smaller banks were not provided with liquidity support, despite being well capitalised and solvent. They could have been supported through lender of last resort facilities. The mechanism for such support was, however, not in place at the time.[1] If South Africa is to develop a viable small banking tier, a clear ex ante liquidity support and deposit insurance scheme will be important to ensure confidence in smaller banks, particularly during periods of financial market disturbances.

The small bank crisis took place prior to the 2008 global financial crisis. Many of the lessons of that crisis (and the small bank crisis) were incorporated into

[1] More recent reforms, including the introduction of a committed liquidity facility (CLF), provides an ex ante lender of last resort facility.

improving the authorities' response to the African Bank failure in 2014.

Indeed, the response during the failure of African Bank was substantially better – the resolution plan was extensive, detailed and immediate. Actions were taken in non-banking components of the financial system – for example, discretionary liquidity restrictions (a type of gating restriction) were imposed on money-market funds. Moreover, market making facilities were extended to potentially affected overnight instruments issued by other banks. If anything the Reserve Bank may have 'over-reacted', with a relatively generous haircut (bonds that were trading at 66c on the rand were discounted to 90c on the rand). There was also clear guidance given to the public on the solvency of other banks (particularly Capitec, which had similar assets but a very different funding profile). The effect was to forestall spillovers. The authorities' response to the Saambou and African Bank failures also highlighted gaps in the legal and regulatory framework. Each of the failing banks (Saambou and African Bank) understated their non-performing loans; similarly VBS Mutual Bank appears to have done the same. The list of bank failures in the appendix highlights how common outright fraud has been in South African banking failures.

Legislation had to be tabled at short-notice in Parliament to facilitate the African Bank bail-in (particularly the ability to transfer assets and liabilities to the 'good bank'). To facilitate future events, new legislation has recently been published.

This legislation also introduced a new system of deposit insurance and depositor preference. I demonstrated, however, that deposit insurance would not have staunched the run during the small-bank crisis. This is because the affected liabilities were not retail.

That said, a more important component of recent proposed reforms is to introduce depositor preference, i.e. that retail depositors rank senior to other liability holders during liquidation. This will have two benefits – first, it will ensure that ordinary retail depositors are paid out first from the proceeds of failures; and, second, it will reduce the implicit exposure of the sovereign.

5.5 Limitations of the research

Bank failures are relatively rare and have idiosyncratic features, which limit their usefulness for drawing general conclusions. That said there is a healthy international literature (as discussed in this study) that shows that individual bank failures can contribute to a better understanding of the practice of central banking. Nevertheless, the lessons drawn in this study should be seen in light of the limited South African experience. Inevitably, future bank failures and financial crises will have their own unique causes and consequences.

I assembled large data sets for each of the periods I examined. In chapter 2, the data set comprised new bank-level information on 217 balance sheet items. In Chapter 3, a new capital adequacy variable was obtained from the regulator and incorporated into an existing model. In chapter 4, in addition to the publicly-available industry data set, I assembled two new data sets: one quarterly data set with financial-instrument level information, and one daily data set.

Such extensive data sets are not readily available, can only be constructed after the fact, and are often incomplete. This limits the ability to build ongoing risk monitoring frameworks. In particular, there is a lack of regularly updated data on interconnectedness – bank failures often propagate through a series of opaque and misunderstood interlinkages, and there are substantial data gaps. For example, data could be collected and made available on inter-bank exposures to better understand linkages.

5.6 Future research

5.6.1 The appropriate tools

This study highlighted the broader role of the central bank in managing periods of financial market distress and dislocations. I assessed the usefulness of one policy tool, the counter-cyclical capital buffer. However, the tool has a number of weaknesses (see, for example, Farrell (2016)). There are a number of other possible tools that could be used (see the discussion in chapter 2, and Cerutti et al. (2015); Sinclair and Farrell (2017); Havemann (2013)). These include loan-

to-value ratios, leverage caps, and time-varying reserve requirements. Further work at an individual country level and cross country are useful to understand not only the economic effects, but also the practicalities of using these tools.

The increase in capital adequacy requirements in the pre-2008 period was due to a *generalised* increase in credit growth – the Saambou and African Bank cases were two *specific* banks that experienced credit growth. It does not necessarily follow that the appropriate policy response is to impose macroprudential policy tools on *all* banks – it may be sufficient to impose them only on affected banks.

5.6.2 Institutional structure

Eichengreen (2014) highlights that historical analyses are useful because they bring in the institutional context. The decision-making in a central bank is critical – for example, how decisions are made when there are potential trade-offs between financial stability and inflation targeting.

Sinclair and Farrell (2017) note that the combination of overheating financial conditions and low inflation is a period of 'conflicting' policy objectives. For South Africa, they show that monetary policy and macroprudential policy conflicted as often as 30 per cent of the time. Under the new 'Twin Peaks' approach to financial sector regulation, the Reserve Bank has restructured its decision-making framework. Monetary policy decisions are made by a monetary policy committee, while financial stability decisions are made by a financial stability committee. There are overlapping members. However, more work needs to be done to understand how the trade-offs might be managed.

For example, I showed in chapter 2 that the monetary policy committee raised interest rates in the second week of a banking crisis, to dampen inflation. In chapter 3, I outlined some of the considerations in how financial stability and interest-rate decisions can be made. Further research is needed on how to best structure decision making in a central bank with a financial stability mandate. This will be particularly context and jurisdictional specific.[2] A review of the literature showed

[2]In South Africa, there is a natural coordination advantage from having banking supervision in the central bank. In Europe, monetary policy decisions are made by the European Central Bank, and macroprudential decisions are made by individual central banks in each jurisdiction. In Australia, supervisory decisions (such as overall capital adequacy levels) are made by the

that game theory provides a useful way of thinking through these issues. The two 'players' are the monetary and macroprudential decision makers. Their 'play' is respectively interest rate changes or macroprudential policy changes. Future research could build out on how to improve the coordination of decision making, and incorporate financial stability measures in monetary policy and vice-versa.

5.6.3 The role of liquidity

The Reserve Bank operates a 'classical cash reserve' or 'liquidity deficit framework' for the implementation of monetary policy, with the repo rate as the operational variable. The Reserve Bank sets the overnight rate, and the quantity of money adjusts (South African Reserve Bank, 2005). This is in contrast with other jurisdictions that run an open-market system, where open-market operations are used to achieve a desired interest rate (see, for example Allen et al. (2009) and for a discussion comparing the systems see Havemann (2013)). However, the critical disadvantage to the current system appears to be that it makes monitoring and responding to financial-system liquidity conditions potentially more difficult (Brink and Kock, 2009).

5.7 Concluding remarks

It has been a decade since the failure of Lehman's Brothers on 15 September 2008. Policymakers have grappled with a number of issues in the years since the 2008 global financial crisis. In that period, the immediacy of the crisis led to a number of substantial reforms, both internationally and domestically. In South Africa, these reforms included the review of the financial regulatory system to introduce a 'Twin Peaks' system, the introduction of a new recovery and resolution framework for banks, and a deposit insurance scheme.

As that crisis fades from memory, ongoing work is required to ensure that the system remains robust to both domestic and international shocks. These shocks may take the form of bank failures or other types of failures.

Australian Prudential Regulatory Authority, while macroprudential and monetary decisions are made by the Reserve Bank of Australia.

During the final months of this study, VBS Mutual Bank failed. It was the first retail deposit bank that failed since the Saambou crisis, sixteen years earlier. Ordinary South Africans slept outside bank branches during the winter of 2018 to ensure that they were first in the queue when the bank opened. The largest retail depositors were community funeral 'stokvels', and funerals were delayed while the bank rescue plan was finalised. This was a repeat of history – when Saambou and African Bank collapsed, thousands of ordinary people lost their pension savings. The government intervention could only offer limited help. Governments simply do not have the significant resources to bail out banks.

List of References

Acemoglu, D., Ozdaglar, A. and Tahbaz-Salehi, A. (2015), 'Systemic risk and stability in financial networks', *The American Economic Review* **105**(2), 564–608.

Acemoglu, D. and Robinson, J. A. (2005), *Economic origins of dictatorship and democracy*, Cambridge University Press, Cambridge.

Acharya, V. (2009), 'A theory of systemic risk and design of prudent bank regulation', *Journal of Financial Stability* **5**, 224–255.

Acharya, V. V., Schnabl, P. and Suarez, G. (2013), 'Securitization without risk transfer', *Journal of Financial Economics* **107**(3), 515–536.

Adam, A. and Karanatsis, K. (2018), 'Sovereign defaults and democracy', *Comparative Economic Studies* pp. 1–27.

Ahnert, T. and Georg, C.-P. (2018), 'Information contagion and systemic risk', *Journal of Financial Stability* **35**, 159–171.

Aiken, A. L., Clifford, C. P. and Ellis, J. A. (2015), 'Hedge funds and discretionary liquidity restrictions', *Journal of Financial Economics* **116**(1), 197–218.

Aikman, D. and Paustian, M. O. (2006), Bank capital, asset prices and monetary policy, Working paper 305, Bank of England. Own publication.

Aliaga-Díaz, R. and Olivero, M. P. (2012), 'Do bank capital requirements amplify business cycles? bridging the gap between theory and empirics', *Macroeconomic Dynamics* **16**(3), 358–395.

Allen, F., Beck, T., Carletti, E., Lane, P. R., Schoenmaker, D. and Wagner, W. (2011), Cross border banking in Europe: Implications for financial stability and macroeconomic policies, CEPR report, London.

Allen, F., Carletti, E. and Gale, D. (2009), 'Interbank market liquidity and central bank intervention', *Journal of Monetary Economics* **56**(5), 639–652.

Allen, F. and Gale, D. (2000), 'Financial contagion', *Journal of Political Economy* **108**(1), 1–33.

Allen, F. and Gale, D. (2004), 'Competition and financial stability', *Journal of Money, Credit and Banking* pp. 453–480.

Allen, F., Krahnen, J. P. and Rey, H. (2017), Financial resilience revisited: Why consistency in regulation is now paramount-across sectors and regions, and over time, Technical report, SAFE Policy Letter.

Angeletos, G. M., Hellwig, C. and Pavan, A. (2006), 'Signaling in a global game: Coordination and policy traps', *Journal of Political Economy* **114**(3), 452–484.

Angelini, P., Neri, S. and Panetta, F. (2014), 'The interaction between capital requirements and monetary policy', *Journal of Money, Credit and Banking* **46**(6), 1073–1112.

Arellano, M. (1987), 'Computing robust standard errors for within-groups estimators', *Oxford Bulletin of Economics and Statistics* **49**(4), 431–434.

Arndt, E. H. D. (1928), Banking and currency development in South Africa (1652-1927): With an appendix on the rise of savings banking in South Africa, PhD thesis, Columbia University.

Athey, S. (2017), The impact of machine learning on economics, *in* G. J. Agrawal, Ajay K. and A. Golfarb, eds, 'The Economics of Artificial Intelligence', University of Chicago Press.

Avgouleas, E. and Goodhart, C. (2015), 'Critical reflections on bank bail-ins', *Journal of Financial Regulation* **1**, 1–27.

Baeriswyl, R. and Cornand, C. (2010), 'The signaling role of policy actions', *Journal of Monetary Economics* **57**(6), 682–695.

Battiston, S., Gatti, D. D., Gallegati, M., Greenwald, B. and Stiglitz, J. E. (2012), 'Default cascades: When does risk diversification increase stability?', *Journal of Financial Stability* **8**(3), 138–149.

Beau, D., Clerc, L. and Mojon, B. (2012), 'Macro-prudential policy and the conduct of monetary policy', *Banque de France Occasional Papers* (8).

Bennett, R. L., Güntay, L. and Unal, H. (2015), 'Inside debt, bank default risk, and performance during the crisis', *Journal of Financial Intermediation* **24**(4), 487–513.

Bernanke, B. S. and Blinder, A. S. (1988), 'Credit, money, and aggregate demand', *The American Economic Review* **78**(2), 435–439.

Bernanke, B. S. and Blinder, A. S. (1992), 'The federal funds rate and the channels of monetary transmission', *The American Economic Review* **82**(4), 901–921.

Bernanke, B. S. and Gertler, M. (1995), 'Inside the black box: the credit channel of monetary policy transmission', *Journal of Economic Perspectives* **9**(4), 27–48.

Bernanke, B. S. and Gertler, M. (2001), 'Should central banks respond to movements in asset prices?', *American Economic Review* **91**(2), 253–257.

Bernanke, B. S., Gertler, M. and Gilchrist, S. (1999), 'The financial accelerator in a quantitative business cycle framework', *Handbook of Macroeconomics* **1**, 1341–1393.

Bikker, J. A. and Hu, H. (2002), 'Cyclical patterns in profits, provisioning and lending of banks and procyclicality of the new Basel capital requirements', *Banca Nazionale del Lavoro Quarterly Review* **55**(221), 143.

Blackbeard, M. (2014), *"Training notes: List of bank failures in South Africa, 1990 - 2014."*, South African Reserve Bank.

Blanchard, O., Dell'Ariccia, G. and Mauro, P. (2010), 'Rethinking macroeconomic policy', *Journal of Money, Credit and Banking* **42**(s1), 199–215.

Blanchard, O., Ostry, J. D., Ghosh, A. R. and Chamon, M. (2016), 'Capital flows: Expansionary or contractionary?', *American Economic Review* **106**(5), 565–69.

Blinder, A. S. and Reis, R. (2005), Understanding the Greenspan Standard, Symposium sponsored by the Federal Reserve Bank of Kansas City, 'The Greenspan Era: Lessons for the Future', Jackson Hole, Wyoming, USA, pp. 11–96.

Bordo, M. D. and Haubrich, J. G. (2017), 'Deep recessions, fast recoveries, and financial crises: Evidence from the American record', *Economic Inquiry* **55**(1), 527–541.

Borio, C. (2014), 'The financial cycle and macroeconomics: What have we learnt?', *Journal of Banking & Finance* **45**, 182–198.

Borio, C. E. and Lowe, P. W. (2002), 'Asset prices, financial and monetary stability: Exploring the nexus'.

Borio, C., Furfine, C., Lowe, P. et al. (2001), 'Procyclicality of the financial system and financial stability: Issues and policy options', *BIS Papers* **1**(March), 1–57.

Borio, C. and Zhu, H. (2012), 'Capital regulation, risk-taking and monetary policy: A missing link in the transmission mechanism?', *Journal of Financial Stability* **8**(4), 236–251.

Botha, B., de Jager, S., Ruch, F. and Steinbach, R. (2017), 'The quarterly projection model of the sarb'.

Brink, N. and Kock, M. (2009), Central bank balance sheet policy in South Africa and its implications for money-market liquidity, Working paper 01/09, South African Reserve Bank.

Bryant, J. (1980), 'A model of reserves, bank runs and deposit insurance', *Journal of Banking and Finance* **4**, 335–344.

Calomiris, C. W. (2008), 'Banking crises', *NBER Reporter* **4**, 10–14.

Calomiris, C. W. and Gorton, G. (1991), The origins of banking panics: Models, facts, and bank regulation, *in* 'Financial markets and financial crises', University of Chicago Press, pp. 109–174.

Calomiris, C. W. and Mason, J. R. (2003), 'Consequences of bank distress during the great depression', *The American Economic Review* **93**(3), 937–947.

Capie, F., Fischer, S., Goodhart, C. and Schnadt, N. (1994), *The future of central banking: the tercentenary symposium of the Bank of England*, Cambridge University Press, Cambridge.

Caprio, Gerald, J. and Klingebiel, D. (2003), Episodes of systemic and borderline financial crises, Technical report, World Bank.

Carlsson, H. and van Damme, E. (1993), 'Global games and equilibrium selection', *Econometrica: Journal of the Econometric Society* **61**(5), 989–1018.

Caruana, J., Cohen, B. H. et al. (2014), 'Five questions and six answers about macroprudential policy', *Banque de France Financial Stability Review* (18), 15–23.

Cecchetti, S. G. and Kohler, M. (2012), When capital adequacy and interest rate policy are substitutes (and when they are not), Working paper 379, Bank for International Settlements.

Cerutti, E., Claessens, S. and Laeven, M. L. (2015), The use and effectiveness of macroprudential policies: New evidence, Working paper 15/61, International Monetary Fund.

Chari, V. and Jagannathan, R. (1988), 'Banking panics, information and rational expectations equilibrium', *Journal of Finance* **43**, 749–761.

Chen, Q., Goldstein, I. and Jiang, W. (2010), 'Payoff complementarities and financial fragility: Evidence from mutual fund outflows', *Journal of Financial Economics* **97**(2), 239–262.

Christiano, L. J. and Fitzgerald, T. J. (2003), 'The band pass filter', *International Economic Review* **44**(2), 435–465.

Cici, G., Kempf, A. and Sorhage, C. (2017), 'Do financial advisors provide tangible benefits for investors? evidence from tax-motivated mutual fund flows', *Review of Finance* **21**(2), 637–665.

Cipriani, M., Martin, A., McCabe, P. and Parigi, B. M. (2014), Gates, fees, and preemptive runs, New York Federal Reserve Staff Report 670.

Claessens, S., Ghosh, S. R. and Mihet, M. R. (2014), *Macro-prudential policies to mitigate financial system vulnerabilities*, number 14-155, International Monetary Fund.

Clement, P. (2010), 'The term 'macroprudential': origins and evolution', *BIS Quarterly Review* pp. 59 – 67.

Comin, D. and Gertler, M. (2006), 'Medium-term business cycles', *American Economic Review* **96**(3), 523–551.

Corbae, D. and D'Erasmo, P. (2014), 'Capital requirements in a quantitative model of banking industry dynamics'.

Covas, F. and Fujita, S. (2010), 'Procyclicality of capital requirements in a general equilibrium model of liquidity dependence', *International Journal of Central Banking* **6**(4), 137–173.

Cox, D. R. (1972), 'Regression models and life tables', *Journal of the Royal Statistical Society* **34**(2), 187–220.

Cox, R. A., Kimmel, R. K. and Wang, G. W. (2017), 'Proportional hazards model of bank failure: Evidence from USA', *Journal of Economic & Financial Studies* **5**(3), 35–45.

Curdia, V. and Woodford, M. (2010), 'Credit spreads and monetary policy', *Journal of Money, Credit and Banking* **42**, 3–35.

De Bruyckere, V., Gerhardt, M., Schepens, G. and Vander Vennet, R. (2013), 'Bank/sovereign risk spillovers in the European debt crisis', *Journal of Banking & Finance* **37**(12), 4793–4809.

De Jager, S., Johnston, M. and Steinbach, R. (2015), A revised quarterly projection model for South Africa, Working paper 15/03, South African Reserve Bank.

De Resende, C., Dib, A., Lalonde, R. and Perevalov, N. (2016), 'Countercyclical bank capital requirement and optimized monetary policy rules', *Emerging Markets Finance and Trade* **52**(10), 2267–2291.

Dell'Ariccia, M. G., Rabanal, P., Crowe, C. W. and Igan, D. (2011), *Policies for Macrofinancial Stability: Options to Deal with Real Estate Booms*, Washington, D.C. Own publication.

DeLong, J. B. and Summers, L. H. (1986), The changing cyclical variability of economic activity in the United States, *in* 'The American business cycle: Continuity and change', University of Chicago Press, pp. 679–734.

Dewatripont, M. and Freixas, X. (2012), Bank resolution: Lessons from the crisis, *in* M. Dewatripont and X. Freixas, eds, 'The Crisis aftermath: New regulatory paradigms', Centre For Economic Policy Research.

Diamond, D. W. and Dybvig, P. H. (1983), 'Bank runs, deposit insurance, and liquidity', *Journal of Political Economy* **91**(3), 401–419.

Diamond, D. W. and Rajan, R. G. (2009), Illiquidity and interest rate policy, Technical report, National Bureau of Economic Research.

Drehmann, M., Borio, C. E. and Tsatsaronis, K. (2012), Characterising the financial cycle: don't lose sight of the medium term!, Working paper 380, Bank for International Settlements.

Du Plessis, S. (2010), 'Implications for models in monetary policy', *Journal of Economic Methodology* **17**(4), 429–444.

Du Plessis, S. (2012), Assets matter: New and old views of monetary policy, Working paper 16/2012, Stellenbosch University, Department of Economics.

Du Plessis, S., du Rand, G. et al. (2011), On the (non-) equivalence of capital adequacy and monetary policy: A response to Cechetti and Kohler, Working paper 04/2011, Stellenbosch University, Department of Economics.

Eichengreen, B. (2014), 'Methodology of economic history as an approach to assessing monetary policy', *Journal of Economic Dynamics and Control* **49**, 154–155.

Eichengreen, B. (2017), The Great Depression and the Great Recession in a historical mirror, *in* E. Alvi, ed., 'Confronting policy challenges of the Great Recession: Lessons for macroeconomic policy', WE Upjohn Institute, p. 13.

Eichengreen, B. and Mitchener, K. J. (2004), The great depression as a credit boom gone wrong, *in* S. Wolcott and C. Hanes, eds, 'Research in economic history', Vol. 22, Emerald Group Publishing Limited, pp. 183–237.

Engle, R. F. and Granger, C. W. (1987), 'Co-integration and error correction: representation, estimation, and testing', *Econometrica: Journal of the Econometric Society* pp. 251–276.

Estrella, A., Park, S. and Peristiani, S. (2002), 'Capital ratios and credit ratings as predictors of bank failures', *Federal Reserve Bank of New York: Economic Policy Review* pp. 33–52.

Farrell, G. (2016), 'Countercyclical capital buffers and real-time credit to GDP gap estimates: a South African perspective', *Studies in Economics and Econometrics* **40**(1), 1–20.

Farrell, G. and Kemp, E. (2017), Measuring the financial cycle in South Africa, Working paper 736, Economic Research South Africa.

FDIC (2018), *Risk Management Manual of Examination Policies*, Federal Deposit Insurance Corporation, New York.

Financial Services Board (2014), 'Board notice 90 - collective investments schemes'. Own publication, Pretoria.

Financial Stability Board (2014), 'Key attributes of effective resolution regimes for financial institutions'. Own publication, Basel.

Financial Stability Board (2015), 'Global shadow banking monitoring report 2015'. Own publication, Basel.

Financial Stability Board (2016), 'Second thematic review on resolution regimes'. Own publication, Basel.

Fourie, J. (2016), 'The data revolution in African economic history', *Journal of Interdisciplinary History* **47**(2), 193–212.

Fourie, J. (2018), Cliometrics in South Africa, Working paper 14/2018, Stellenbosch University, Department of Economics.

Friedman, M. (1968), 'The role of monetary policy', *The American Economic Review* **58**(1), 1–17.

Friedman, M. and Schwartz, A. (1963), *A monetary history of the United States, 1867–1960*, Princeton University Press, Princeton.

Fuhrer, J. and Estrella, A. (1999), Are 'deep' parameters stable? The Lucas Critique as an empirical hypothesis, Working paper 99-4, Society for Computational Economics Research Department.

Funke, M., Schularick, M. and Trebesch, C. (2016), 'Going to extremes: Politics after financial crises, 1870–2014', *European Economic Review* **88**, 227–260.

Gai, P., Haldane, A. and Kapadia, S. (2011), 'Complexity, concentration and contagion', *Journal of Monetary Economics* **58**(5), 453–470.

Galati, G. and Moessner, R. (2013), 'Macroprudential policy–a literature review', *Journal of Economic Surveys* **27**(5), 846–878.

Gasiorowski, M. J. (1995), 'Economic crisis and political regime change: An event history analysis', *American Political Science Review* **89**(4), 882–897.

Geithner, T. F. (2014), *Stress Test: Reflections on Financial Crises*, Random House, New York.

Gilbert, E., Calitz, E. and Du Plessis, S. (2009), 'Prudential regulation, its international background and the performance of the banks: a critical review of the South African environment since 1970', *South African Journal of Economic History* **24**(2), 43–81.

Glasserman, P. and Young, H. P. (2015), 'How likely is contagion in financial networks?', *Journal of Banking & Finance* **50**, 383–399.

Goldstein, I., Jiang, H. and Ng, D. (2016), 'Investor flows and fragility in corporate bond funds', Mimeo.

Goldstein, I. and Pauzner, A. (2005), 'Demand-deposit contracts and the probability of bank runs', *Journal of Finance* **60**(3), 1293–1327.

Goodfriend, M. (2007), 'How the world achieved consensus on monetary policy', *Journal of Economic Perspectives* **21**(4), 47–68.

Goodfriend, M. and King, R. G. (1988), 'Financial deregulation, monetary policy, and central banking', *Economic Review* (May), 3–22.

Goodhart, C. (2010), 'Are cocos from cloud cuckoo-land?', http://voxeu.org/article/are-cocos-cloud-cuckoo-land.

Goodhart, C. A. (2002), 'The organizational structure of banking supervision', *Economic Notes* **31**(1), 1–32.

Goodhart, C. A. E. (2011), 'The changing role of central banks', *Financial History Review* **18**(2), 135–154.

Gorton, G. B. (2008), The panic of 2007, Working paper 14358, National Bureau of Economic Research.

Gorton, G., Metrick, A. and Xie, L. (2014), The flight from maturity, Working paper 20027, National Bureau of Economic Research.

Green, P. (2012), *Choice not fate: The life and times of Trevor Manuel*, Penguin UK, London.

Grobler, C. and Smit, B. (2015), Enhancing the financial sector linkages in the Bureau for Economic Research's core macroeconometric model, Working paper 21/2015, Stellenbosch University, Department of Economics.

Haldane, A. G. and May, R. M. (2011), 'Systemic risk in banking ecosystems', *Nature* **469**(7330), 351–355.

Havemann, R. (2013), Macroprudential policy design: Four puzzles for policymakers, Working paper 35, Economic Research South Africa.

Havemann, R. (2014), 'The exchange control system under apartheid', *Economic History of Developing Regions* **29**(2), 268–286.

Havemann, R. and Fourie, J. (2015), The Cape of perfect storms: colonial Africa's first financial crash, 1788–1793, Working paper 511, Economic Research Southern Africa, Cape Town.

Hett, F. and Schmidt, A. (2014), Bank rescues and bailout expectations: The erosion of market discipline during the financial crisis, Working paper 36, SAFE.

Huang, R. and Ratnovski, L. (2011), 'The dark side of bank wholesale funding', *Journal of Financial Intermediation* **20**(2), 248–263.

Hüser, A.-C., Halaj, G., Kok, C., Perales, C. and van der Kraaij, A. F. (2017), The systemic implications of bail-in: A multi-layered network approach, Working paper 2010, European Central Bank.

Hwa, V., Kapinos, P. and Ramirez, C. D. (2017), 'Does regulatory bank oversight impact economic activity? A local projections approach', *Journal of Financial Stability* .

ING Barings (2002), 'Deregistration of Brait Merchant Bank Limited as a banking institution and comment on earnings expectations.'. Own publication.

International Monetary Fund (2008), *Financial Stability Assessment Program: South Africa*, International Monetary Fund, Washington, D.C.

Issing, O. (2011), Lessons for monetary policy: What should the consensus be?, Working paper 11-97, International Monetary Fund, Washington, D.C.

Iyer, R. and Peydro, J.-L. (2011), 'Interbank contagion at work: Evidence from a natural experiment', *The Review of Financial Studies* **24**(4), 1337–1377.

Iyer, R., Puri, M. and Ryan, N. (2012), 'Understanding bank runs: Do depositors monitor banks?', *The American Economic Review* **102**(4), 1414–1445.

Iyer, R., Puri, M. and Ryan, N. (2016), 'A tale of two runs: Depositor responses to bank solvency risk', *The Journal of Finance* **71**(6), 2687–2726.

Jacklin, C. J. and Bhattacharya, S. (1988), 'Distinguishing panics and information-based bank runs: Welfare and policy implications', *Journal of Political Economy* **96**(3), 568–92.

Jalil, A. J. (2015), 'A new history of banking panics in the United States, 1825–1929: Construction and implications', *American Economic Journal: Macroeconomics* **7**(3), 295–330.

Johansen, S. (1992), 'Testing weak exogeneity and the order of cointegration in UK money demand data', *Journal of Policy Modeling* **14**(3), 313–334.

Johansen, S. (1995), *Likelihood-Based Inference in Cointegrated Vector Autoregressive Models*, Oxford University Press.

Johnston, J. and DiNardo, J. (1997), *Econometric methods*, 4 edn, McGraw Hill, New York.

Jones, F. S. (1999), 'The algamation movement in banking in South Africa, 1863–1920', *South African Journal of Economics* **67**(1), 52–71.

Jones, S. (2003), 'The banking sector in the 1990s', *South African Journal of Economic History* **18**(1-2), 238–274.

Jooste, C. and Marinkov, M. (2012), 'South Africa's transition to a consolidated budget', *South African Journal of Economics* **80**(2), 181–199.

Jordaan, M. (1997), The regulation of deposit-taking financial institutions: a comparative analysis of the United Kingdom; Germany and South Africa, PhD thesis, University of Stellenbosch.

Kacperczyk, M. and Schnabl, P. (2013), 'How safe are money market funds?', *The Quarterly Journal of Economics* **128**(3), 1073–1122.

Kaminsky, G. L. and Reinhart, C. M. (1999), 'The twin crises: the causes of banking and balance-of-payments problems', *American Economic Review* **89**(3), 473–500.

Kashyap, A. K. and Stein, J. C. (1995), The impact of monetary policy on bank balance sheets, *in* 'Carnegie-Rochester Conference Series on Public Policy', Vol. 42, Elsevier, pp. 151–195.

Kganyago, L. (2012), 'The impact of the eurozone and global financial crisis on south africa'. Speech by Deputy Governor of the South African Reserve Bank.

Kindleberger, C. P. (1996), The lender of last resort: Pushing the doctrine too far?, *in* F. Capie and G. E. Wood, eds, 'Monetary economics in the 1990s', Springer, pp. 122–136.

King, M. (2016), *The end of alchemy: Money, banking, and the future of the global economy*, WW Norton & Company, London.

Kiyotaki, N. and Moore, J. (1997), 'Credit cycles', *Journal of Political Economy* **105**(2), 211–248.

Koseff, S. (1984), Bank failure in South Africa, Master's thesis, University of Witwatersrand.

Kupiec, P., Lee, Y. and Rosenfeld, C. (2017), 'Does bank supervision impact bank loan growth?', *Journal of Financial Stability* **28**, 29–48.

Laeven, L. and Valencia, F. (2013), 'Systemic banking crises database', *IMF Economic Review* **61**(2), 225–270.

Lane, P. R. (2012), 'The European sovereign debt crisis', *The Journal of Economic Perspectives* **26**(3), 49–67.

Lane, W. R., Looney, S. W. and Wansley, J. W. (1986), 'An application of the Cox proportional hazards model to bank failure', *Journal of Banking & Finance* **10**(4), 511–531.

Lim, C. H., Costa, A., Columba, F., Kongsamut, P., Otani, A., Saiyid, M., Wezel, T. and Wu, X. (2011), Macroprudential policy: what instruments and how to use them? Lessons from country experiences, Working paper WP11/238, International Monetary Fund, Washington, D.C.

Liu, G. and Molise, T. (2018), Is Basel III counter-cyclical? the case of South Africa, Working paper 10/2018, Stellenbosch University, Department of Economics.

Lucas Jr, R. E. (1976), Econometric policy evaluation: A critique, *in* 'Carnegie-Rochester conference series on public policy', Vol. 1, Elsevier, pp. 19–46.

Lucas Jr, R. E. (2003), 'Macroeconomic priorities', *American Economic Review* **93**(1), 1–14.

MacKinnon, J. G. and White, H. (1985), 'Some heteroskedasticity-consistent covariance matrix estimators with improved finite sample properties', *Journal of econometrics* **29**(3), 305–325.

Manuel, T. A. (2009), *Budget Speech*, National Treasury.

Martin, C., Puri, M. and Ufier, A. (2017), Deposit inflows and outflows in failing banks: The role of deposit insurance, Working paper 24589, National Bureau of Economic Research.

Mbuya, J. C. (2003), *The Rise and Fall of Saambou Bank*, Mbuya Books, Johannesburg.

Mésonnier, J.-S. and Stevanovic, D. (2013), 'Bank leverage shocks and the macroeconomy: a new look in a data-rich environment', *Cahier de recherche/Working Paper* **13**, 30.

Mésonnier, J.-S. and Stevanovic, D. (2017), 'The macroeconomic effects of shocks to large banks' capital', *Oxford Bulletin of Economics and Statistics* **79**(4), 546–569.

Miller, M. H. (1995), 'Do the M & M propositions apply to banks?', *Journal of Banking & Finance* **19**(3-4), 483–489.

Minister of Finance (2002), 'The placement of Saambou Bank Limited under curatorship, in terms of Section 69 of the Banks Act', http://www.treasury.gov.za/comm_media/speeches/2002/2002021401.pdf. Statement to Parliament.

Mittner, M. (2003*a*), 'Saambou: At what cost?', *fin24* .

Mittner, M. (2003*b*), 'Wiese given the sack', *fin24* .

Morris, S., Shim, I. and Shin, H. S. (n.d.).

Morris, S. and Shin, H. S. (1999), Coordination risk and the price of debt, Discussion paper 1241, Cowles Foundation for Research in Economics, Yale University.

Morris, S. and Shin, H. S. (2000), Rethinking multiple equilibria in macroeconomic modelling, *in* B. Bernanke and K. Rogoff, eds, 'NBER Macroeconomics Annual 2000', MIT Press, Cambridge, MA.

Morris, S. and Shin, H. S. (2003), Global Games: Theory and applications, *in* L. P. H. Stephen J. Turnovsky, Mathias Dewatripont, ed., 'Advances in Economics and Econometrics', Cambridge University Press, Cambridge, pp. 56–114.

Myburgh, J. (2016), 'Report of the Commissioner's investigation into African Bank Limited', Available online at www.resbank.co.za.

National Treasury (2011), 'A safer financial sector to serve South Africa better', *National Treasury Policy Document* . Own publication, Pretoria.

Nier, E. (2009), Financial stability frameworks and the role of central banks: Lessons from the crisis, Working paper 09/70, International Monetary Fund, Washington, D.C.

Nier, E., Yang, J., Yorulmazer, T. and Alentorn, A. (2007), 'Network models and financial stability', *Journal of Economic Dynamics and Control* **31**, 2033–2060.

Parlatore, C. (2016), 'Fragility in money market funds: Sponsor support and regulation', *Journal of Financial Economics* **121**(3), 595–623.

Perotti, E. and Flannery, M. (2011), 'Coco design as a risk preventive tool', http://voxeu.org/article/coco-bonds-way-preventing-risk.

Persaud, A. D. (2014), Why bail-in securities are fool's gold, Policy brief 14-23, Petersen Institute for International Economics.

Pesaran, M. H. and Smith, R. (1995), 'Estimating long-run relationships from dynamic heterogeneous panels', *Journal of Econometrics* **68**(1), 79–113.

Porteous, D. and Hazelhurst, E. (2004), *Banking on change: Democratising finance in South Africa 1994-2004*, Juta and Company Ltd, Pretoria.

Postlewaite, A. and Vives, X. (1987), 'Bank runs as an equilibrium phenomenon', *Journal of Political Economy* **95**(3), 485–491.

Provopoulos, G. A. (2014), 'The Greek economy and banking system: Recent developments and the way forward', *Journal of Macroeconomics* **39**, 240–249.

PSG Limited (2003), 'Annual report', www.sharedata.co.za/Data/000561/pdfs/PSG_ar_03.pdf.

Rajan, R. G. (2006), 'Has finance made the world riskier?', *European Financial Management* **12**(4), 499–533.

Registrar of Banks (2002), 'Registrar of Banks Annual Report'.

Reinhart, C. M. and Rogoff, K. S. (2009), *This time is different: Eight centuries of financial folly*, Princeton University Press, Princeton.

Reinhart, C. M. and Rogoff, K. S. (2013), 'Banking crises: An equal opportunity menace', *Journal of Banking & Finance* **37**(11), 4557–4573.

Reinhart, C. M. and Rogoff, K. S. (2014), 'Recovery from financial crises: Evidence from 100 episodes', *American Economic Review* **104**(5), 50–55.

Rice, T. and Ors, E. (2006), Bank imputed interest rates: Unbiased estimates of offered rates?, Working paper 2006-26, Federal Reserve Bank of Chicago.

Saayman, A. (2010), *Why money matters: the financial crisis and the South African economy*, Potchefstroom: Noordwes-Universiteit, Potchefstroomkampus (Suid-Afrika).

Saayman, A. (2011), Macroeconomics after four decades of rational expectations, *in* 'Proc. Economic Society of South Africa Biennial Conference'. Conference paper.

Saurina, J. (2009), Dynamic provisioning: The experience of Spain, Note 7, The World Bank, Washington, D.C.

Schmidt, L., Timmermann, A. and Wermers, R. (2016), 'Runs on money market mutual funds', *American Economic Review* **106**(9), 2625–57.

Sewell, A. and Woodrow, R. (2014), South African money market funds: Effect of African Bank exposure limited, Technical report, Fitch Ratings Agency.

Shin, H. S. (2009), 'Reflections on Northern Rock: The bank run that heralded the global financial crisis', *Journal of Economic Perspectives* **23**(1), 101–19.

Shumway, T. (2001), 'Forecasting bankruptcy more accurately: A simple hazard model', *The Journal of Business* **74**(1), 101–124.

Sinclair, P. and Farrell, G. (2017), 'Macroprudential policy challenges: How best to respond?'. Presentation to the Financial Stability Research Conference. Pretoria, South Africa.

Smal, D., Pretorius, C. and Ehlers, N. (2007), The core forecasting model of the South African Reserve Bank, Working paper 07/02, South African Reserve Bank.

South African Reserve Bank (2005), 'The Reserve Bank's system of accommodation', *Fact sheet* (9).

Sundararajan, V. and Balino, T. J. (1991), *Banking crises: cases and issues*, International Monetary Fund, Washington, D.C.

Taylor, J. B. (2009), The financial crisis and the policy responses: An empirical analysis of what went wrong, Working paper 14631, National Bureau of Economic Research.

The World Bank (2016), Bank resolution and bail-in in the EU: selected case studies pre and post BRRD, Working paper 112265, Washington DC.

Tjiane, K. (2015), Curatorship of banks as a means to rescue failing banks, PhD thesis, University of Pretoria.

Torres-Reyna, O. (2010), 'Getting started in fixed/random effects models using r'.

Tulip, P. (2011), 'Fiscal policy and the inflation target', *International Journal of Central Banking* **10**(2), 63–96.

Turner, A. (2009), *The Turner Review: A regulatory response to the global banking crisis*, Vol. 7, Financial Services Authority, London.

Turner, A. (2012), 'Macro-prudential policy in deflationary times'. Speech given during the Financial Policy Committee regional visit to Manchester.

Van Tonder, C. L. (2006), 'The application of nonlinear change theory to the demise of Saambou Bank', *South African Journal of Economic and Management Sciences* **9**(2), 149–174.

Varian, H. R. (2014), 'Big data: New tricks for econometrics', *Journal of Economic Perspectives* **28**(2), 3–28.

Verhoef, G. (2009), 'Concentration and competition: The changing landscape of the banking sector in South Africa 1970-2007', *South African Journal of Economic History* **24**(2), 157–197.

Wermers, R. (2012), Runs on money market mutual funds, Working paper 12-5, Centre for Financial Research, University of Cologne.

Wickens, M. R. and Breusch, T. S. (1988), 'Dynamic specification, the long-run and the estimation of transformed regression models', *The Economic Journal* **98**(390), 189–205.

Zhou, J., Rutledge, V., Bossu, W., Dobler, M., Nadege, J. and Moore, M. (n.d.), From bail-out to bail-in: Mandatory debt restructuring of systemic financial institutions, Staff discussion notes 12/03, International Monetary Fund, Washington, D.C.

Appendices

Appendix A

List of failed banks

Table A.1: Failed banks, 1990 to 2018

	Bank	Year	Reasons	Intervention
1	Alpha Bank	1990	Fraud	Reserve Bank injected R150m, but bank ultimately liquidated (1993)
2	Cape Investment Bank	1991	Fraud (misstatement of non-performing loans)	Reserve Bank provided R5m for depositors
3	Pretoria Bank	1991	Poor management, merger with Masterbond	
4	Sechold Bank	1994	Bank run liquidity problems (derivatives trading loss)	Liquidity, Investec purchased the bank
5	Prima Bank	1994	Liquidity problems due to non-performing loans	Purchase and assumption (by Unibank)
6	African Bank	1995	Bad management and liquidity problems	Government recapitalised the bank
7	Community Mutual Bank	1996	Liquidity problems due to a very high expense to income ratio	Purchase and assumption (by Unibank)
8	Islamic bank	1997	Poor management and improper accounting, particularly around unsecured lending	Liquidated
9	FBC Fidelity Bank	1999	Poor management and liquidity problems	
10	Regal Treasury Bank	2002	Auditors (EY) rescinded their audit approval, precipitating a run	Liquidated
11	New Republic Bank	2002	Poor management and liquidity problems	Liquidated

12	Saambou Bank	2002	Por management	See chapter 2
13	BOE Bank		Contagion	
14	Cadiz Investment Bank		Contagion	
15	FirstCorp Merchant Bank		Contagion	
16	International Bank of Southern Africa		Contagion	
17	Merril Lynch Capital Markets Bank		Contagion	
18	Brait Merchant Bank		Contagion	
19	CorpCapital Bank		Contagion	
20	Old Mutual Bank		Contagion	
21	PSG Investment Bank		Contagion	
22	TA Bank of Southern Africa		Contagion	
23	African Merchant Bank	2003	Contagion	
24	Cape of Good Hope Bank		Contagion	
25	ING Bank NV SA Branch		Contagion	
26	Nedcor Investment Bank		Contagion	
27	RMB Asset Finance Bank		Contagion	
28	Securities Investment Bank		Contagion	
29	Unibank		Contagion	
30	African Bank	2014	Bad management and liquidity problems, particularly around unsecured lending	See chapter 4
31	VBS Mutual Bank	2018	Fraud	Currently underway

Source: Blackbeard (2014) quoted in Tjiane (2015). For failures during the 1800s, see Arndt (1928) and for the 1970s, see Koseff (1984).

Appendix B

Summary of Chapter 2 data

Table B.1: Banks in data set – Liabilities

Balance sheet item	All	Failed				Survive
		All failed	Saambou	First Wave (incl BOE)	Second Wave	All
	31/01/2002		31/01/2002	31/01/2002	31/01/2002	
	Total					
Group NCDs	3.9	0.0	0.0	0.0	0.0	3.9
Group funding - other	15.5	2.5	0.0	0.2	2.3	13.0
Interbank - NCDs	24.2	1.6	0.0	1.6	0.1	22.6
Interbank - other	25.7	2.9	1.0	1.3	0.6	22.8
Government	45.9	2.2	0.4	1.6	0.3	43.7
- Local government	11.3	1.2	0.4	0.5	0.3	10.1
- Financial public corporations	6.2	0.3	0.0	0.3	0.0	5.8
- Non financial public corporations	13.1	1.5	0.1	1.2	0.2	11.7
Insurers	34.9	2.6	0.6	1.7	0.2	32.4
Pension funds	14.6	1.8	0.0	1.6	0.3	12.8
Other financial institituions	104.3	17.4	0.0	16.0	1.3	86.9
Non-financial	172.0	11.6	3.6	6.8	1.1	160.5
Unincorporated business	26.7	0.4	0.0	0.3	0.1	26.3
Individuals	156.7	24.1	8.9	14.4	0.8	132.5
Non-profits	18.9	2.9	0.4	2.4	0.1	16.0
Non-residents	24.7	0.1	0.0	0.1	0.0	24.6
Reserve Bank	0.0	0.0	0.0	0.0	0.0	0.0
Short-term deposits	0.0	0.0	0.0	0.0	0.0	0.0
Other	97.4	5.8	0.0	4.6	1.2	91.6
Other to public	4.0	0.1	0.0	0.0	0.1	3.9
Total to public	851.3	79.8	15.5	55.0	9.3	771.5
	3.6	0.0	0.0	0.0	0.0	3.6
Other liabilities	90.8	3.7	0.3	1.3	2.0	87.2
Total Liabilities	945.7	83.5	15.8	56.4	11.4	862.2
Summary of liabilitiies	0.0	0.2	0.0	0.0	0.2	-0.2
Intergroup	19.4	2.5	0.0	0.2	2.3	16.8
Interbank	49.9	4.6	1.0	2.9	0.6	45.4
Public	76.5	5.3	0.9	3.6	0.8	71.2
Financial	153.8	21.8	0.6	19.3	1.9	132.1
Nonfinancial	172.0	11.6	3.6	6.8	1.1	160.5
Individuals	183.3	24.5	8.9	14.7	0.9	158.8
Nonprofit	18.9	2.9	0.4	2.4	0.1	16.0
Nonres	24.7	0.1	0.0	0.1	0.0	24.6
Other	195.8	9.6	0.3	5.9	3.4	186.2

Table B.2: Banks in data set – Assets

	All 31/01/2002 Total	Failed All failed	Saambou 31/01/2002 SAAMBOU	First Wave (incl BOE) 31/01/2002 First wave	Second Wave 31/01/2002 Second wave	Survive All
All assets	19.6	2.0	0.4	1.4	0.2	17.6
Bank group assets	20.8	0.2	0.0	0.1	0.1	20.6
Interbank	38.2	3.4	0.7	1.5	1.2	34.9
Foreign	2.4	0.0	0.0	0.0	0.0	2.4
Resale agreemnts	16.1	0.7	0.0	0.0	0.7	15.3
Installments	96.0	5.2	1.6	2.8	0.8	90.7
Mortgages	254.6	41.9	8.4	33.1	0.5	212.7
Credit Cards	13.8	0.5	0.1	0.3	0.2	13.3
Commercial debts	18.0	1.1	0.7	0.2	0.1	16.9
Foreign currency loans	131.0	0.5	0.0	0.5	0.0	130.4
Redeemable preference shares	14.8	1.8	0.2	1.6	0.0	13.0
Public sector	7.8	0.0	0.0	0.0	0.0	7.8
Overdrafts - non-banks	26.4	0.0	0.0	0.0	0.0	26.3
Non-financial companies	50.0	1.9	0.0	1.9	0.0	48.1
Unincorporated business	8.0	0.1	0.0	0.1	0.0	7.9
Individuals	13.8	0.3	0.0	0.3	0.0	13.5
Non-profits	1.0	0.2	0.0	0.2	0.0	0.8
Factoring	2.4	0.7	0.0	0.4	0.2	1.7
Other - non-bank private sector	16.9	1.8	0.0	1.0	0.8	15.1
Non-financial companies	70.5	7.7	0.2	6.6	0.8	62.9
Unincorporated business	6.1	0.2	0.0	0.1	0.1	5.9
Individuals	25.8	10.9	4.7	1.2	5.0	14.9
Non-profits	2.8	0.1	0.0	0.1	0.0	2.6
Specific provisions	-13.9	-2.2	-0.6	-1.1	-0.5	-11.6
Other assets	137.0	11.5	0.0	8.0	3.5	125.5
TOTAL ASSETS	1039.3	95.1	17.1	63.7	14.3	944.2
Summary assets						
Central bank money	19.6	2.0	0.4	1.4	0.2	17.6
Deposits, loans and advances	823.1	76.9	16.0	51.0	10.0	746.2
Investments and portfolio assets	137.0	11.5	0.0	8.0	3.5	125.5
Non-financial assets	11.6	1.2	0.1	1.1	0.1	10.4
Other assets	47.9	3.4	0.6	2.2	0.6	44.5
Interbank	61.5	3.6	0.7	1.6	1.3	57.9
Vehicle	112.1	6.0	1.6	2.8	1.5	106.1
Mortgages	254.6	41.9	8.4	33.1	0.5	212.7
Credit card	13.8	0.5	0.1	0.3	0.2	13.3
Companies	96.8	10.4	0.2	8.3	1.9	86.4
Other	298.3	16.8	5.6	6.0	5.2	281.5
NPLs - specific	-13.9	-2.2	-0.6	-1.1	-0.5	-11.6
Other assets	216.1	18.1	1.1	12.8	4.3	198.0